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INVESTIGATION OF CREAM QUALITY.

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SYSTEMATIC investigation of grassland food-taints in milk and cream, carried out on a co-operative basis by the Dairy Research Institute, Department of Agriculture, and the Morrinsville Co-operative Dairy Co., Ltd., was commenced in September, 1934.

Levy(1) established the general causes of these food-taints in certain Waikato areas, and suggested the possibility of reducing the intensity of the flavour by modification of pasture and herd management. In addition to the botanical aspect, the investigations have disclosed a number of points of interest and importance to the dairying industry, and these form the subject-matter of the following notes.

As indicated in Levy's report, night and morning creams from some forty representative farms were subjected daily to critical examination not only for intensity of feediness of flavour of the type characteristic of the Morrinsville, Hinuera, Cambridge, Te Awamutu, and other areas, but also for any other specific flavours, as well as for relative purity from the bacteriological point of view.

On a number of occasions the flavour attributed to land-cress was noted. This flavour, however, appeared only in isolated cases, and seldom, if ever, simultaneously in both night's and morning's cream or on two or more consecutive days from the same farm. The incidence of the flavour was therefore comparatively slight in the Morrinsville area in the season under review. In one instance of pronounced land-cress flavour in cream, search at the farm revealed the presence of only a few land-cress plants around gateways and fences adjacent to the milking-shed. In contrast with this, at another farm in the same district practically all the pastures were known to be heavily infested with the plant, and numerous inspections showed that it was regularly grazed by the herd. Yet careful daily examination of the cream from this farm revealed the typical flavour on one occasion only. The evidence available is meagre, but suggests that the serious trouble which sometimes arises from this source may be traceable to individual cows or to cows in abnormal health, and perhaps to a certain stage of growth

(1) LEVY, E. B.: *N.Z. Journal of Agriculture*, Vol. 50, No. 3, March, 1935.

of the plant. Soil conditions may also have some influence, since in certain areas of New Zealand large percentages of cream are affected each year with this taint. It is well established that taint-producing foods are more potent in effect when consumed within the four-hour period prior to milking, and this, too, may be a factor in the incidence of the taint.

Flavours described as "oily" or, perhaps more correctly, as "tallowy" were noted in a few instances. These flavours were found in their truest form in creams of excellent condition and low bacterial count. Attempts to reproduce the flavour biologically failed in all cases. The addition of small amounts of ferric chloride to low-count cream of good, clean flavour produced a slightly tallowy flavour after eight hours holding and an intense tallowy flavour in twenty-two hours in samples held at room temperature. Samples held at 44° F., and samples to which copper filings had been added, produced metallic flavours less pronounced in tallowiness. Efforts to locate the seat of the trouble at the respective milking-sheds were not always successful, but there is some evidence to suggest that metallic, or mineral oil, contamination was the cause of tallowy flavour in the cream in most instances.

A flavour strongly suggestive of caustic-soda contamination, frequently noted in night cream from one shed, was found to develop with equal intensity in the morning cream if held twenty-four hours. It has been tentatively established that a specific organism is a causative agent in producing this taint, which could be reproduced in twenty-four hours in sound, clean-flavoured milk and cream by inoculation with the organism which had been isolated. In the shed mentioned above the "breather" tube connected to the releaser of the milking plant was found to be heavily infected with this organism, and the trouble disappeared from the cream immediately the tube was replaced and the air system cleaned out.

"Sweet curdling" of cream (distinct from "ropy" cream) was noted on numerous occasions. It is possible that this defect is associated with the presence of milkstone deposits in milking-machines.

Generally, it would be true to say that faults noted in the cream, apart from food-flavours, were in most instances traceable to defective conditions at the sheds, and usually to the milking plant itself. Very often, of course, there is no clear dividing-line between describable flavours and those which can only safely be termed "off" or objectionable. The degrading of cream regarding the flavour of which the grader cannot accurately apply a more precise term than "off" is, naturally, sometimes resented by the supplier. Nevertheless, the present investigations have demonstrated beyond any doubt that the grader's judgment is convincingly supported by the bacteriological condition of such creams. Indeed, if it be accepted that the evidence afforded by bacteriological examination of cream is conclusive, it must also be accepted that, although grading by the senses is seldom at fault in placing creams in a lower grade than is warranted, the senses frequently err in failing to detect the presence of defects which should result in the degrading of the cream.

In a series comprising some 6,000 separate samples of cream, critical grading by the senses classed a third of the samples as "off" or doubtful in purity. Classification by the direct-microscopic-count (Breed) method showed that 18·9 per cent. of the rejected samples gave bacterial counts of under 15,000,000 and 81·1 per cent. over 15,000,000 organisms per cubic centimetre. Records show that the lower-count creams were rejected by the senses chiefly on account of absorbed or chemical flavours. At the same time, large percentages of cream of high bacterial count were classed as "sound" in the judgment of the senses. The evidence clearly points out the limitations of the usual system of grading on the factory stage, especially in respect to cream delivered daily and early in the day, and is indicative of some of the perplexing difficulties well known to be associated with ordinary cream-grading. The position may to some extent be due to variations in the dominant types of organisms present and to fortuitous temperatures hastening or retarding the initial stages of the fermentation process. Orla-Jensen(2) points out that no appreciable amounts of decomposition products are separated in what is known as "the incubation period." The chemical changes brought about by micro-organisms are, of course, manifold. But if the desideratum is purity of the cream-supply, and if grading is to be placed on a more equitable basis, it seems evident that an advanced cream-grading test, supplementary to the senses, is urgently needed.

The presence of food-taints renders consistent grading of cream still more complex—not so much on account of the possibility of confusing "feediness" with contamination (extensive records show that, with care, this error is almost negligible) as on account of the widely varying degree of intensity of feediness and widely varying percentages of cream affected throughout the months when food-taints are prevalent. Levy's report shows how very difficult it would be to establish standards that would prove equitable in the light of present-day knowledge and circumstances; and the extreme difficulty of complying with a rigid standard will be appreciated from the following extracts from records, covering approximately 8,000 separate samples of representative creams, examined twice daily*:—

Percentage of Creams classed as sound in Quality but "feedy" in Flavour.

Period ended	Morning Cream.	Evening Cream.
	Per Cent.	Per Cent.
9/10/34	6·0	47·0
29/10/34	57·0	86·6
29/11/34	15·3	61·9
19/12/34	2·8	16·8

(2) Dairy Bacteriology, 2nd Edition, 1931.

* All samples were examined by two or more graders, who were frequently assisted by Messrs. W. Dempster and E. Melton, of the Dairy Division. The bacteriological and other laboratory services referred to in these notes were carried out by Mr. H. W. Boucher, B.Agr.Sc., of the staff of the Morrinsville Co-operative Dairy Co., Ltd.

Food-flavour Intensities (on Scale of 0 to 100 Points) of Cream from Farms classified by Mr. E. Bruce Levy according to Pasture Types.

	Morning Cream.		Evening Cream.	
Pasture type	1 : 2		1 : 2	
	Points.	Points.	Points.	Points.
9/10/34	1·6	2·2	12·4	27·8
29/10/34	11·4	15·9	24·0	34·8
29/11/34	2·3	2·5	8·2	31·5
19/12/34	0·22	0·5	3·9	3·5

Pasture Type 1, from "heavily manured farms, heavily stocked over a period of years, resulting in a higher producing early spring sward that is dominantly perennial rye-grass and white clover."

Pasture Type 2, from farms "moderately well manured and in process of building up to a high per-acre stocking. . . . The sward is dominantly white clover with rye-grass rising sub-dominant. . . . Cocksfoot, *Poa pratensis*, and Yorkshire fog, with some sweet vernal and suckling clover in the weaker parts, are also present."

In November and December over 4,500 separate samples of morning and evening creams were examined by standard acidity tests, as well as by the senses and by direct bacterial count. The first- and the last-named tests failed to show any correlation with the judgment of the senses in respect to food-taints. This was also true in respect to direct bacterial counts made throughout the season. For comparison of the methods of cream-grading on the basis of soundness of quality—irrespective of food-taints—the standard "pass" acidity was fixed at 0·15 per cent. as lactic acid in November (the figure recommended for universal adoption by the recent Royal Commission) and at 0·2 per cent. in December. A few summarized examples of results will suffice to show that no substantial agreement was found to exist between the judgment of the senses and the standard acidity tests, or between the latter test and direct bacterial counts.

Trials were conducted at intervals in the endeavour to ascertain the value of the methylene-blue test, as applied in simple, direct form to cream, in comparison with the methods cited above. Results were unsatisfactory, and the impression formed is that considerable refinement of technique would require to be evolved before this test could be accepted as of real practical value in the grading of cream.

Experience suggests that many practical difficulties have yet to be overcome before any present-day laboratory test can be put into operation at a reasonable cost in the daily grading of factory cream-supplies. The direct-microscopic-count (Breed) method has a number of special merits that appear to place this test quite definitely in the lead at the present time. Fundamentally it affords a sound means of quickly gauging the relative purity of cream, and it probably carries greater conviction to the mind of the layman than does any other simple test. It is well adapted for use in farm-dairy instructional work, and the

extension of its use to the grading of cream would be a natural and desirable corollary. Modification of minor details may be possible and eventually lead to solution of the practical difficulties of application.

Comparison of Grading by Standard Acidity Test, Direct Microscopic Count, and by the Senses.

A + indicates that acidity of cream was above standard.
A − indicates that acidity of cream was below standard.

Period ended	Standard Acidity.	Percentage of Total Creams graded.					
		Evening Creams.			Morning Creams.		
		A+	A−	Degraded by Senses.	A+	A−	Degraded by Senses.
	Per Cent.						
19/11/34 ..	0·15	82·3	17·7	31·0	24·0	76·0	13·2
31/12/34 ..	0·20	36·4	63·6	40·9	Nil	100·0	3·3

Period ended	Graded by Acidity.	Distribution by Senses: Percentages of each Group.			
		Evening Creams.		Morning Creams.	
		Passed.	Degraded.	Passed.	Degraded.
19/11/34	A+	65·9	34·1	75·4	24·6
	A−	83·6	16·4	90·4	9·6
31/12/34	A+	33·2	66·8	Nil	Nil
	A−	73·9	26·1	96·7	3·3

Period ended	Standard Acidity.	Percentage of Total Creams graded.							
		Evening Creams.				Morning Creams.			
		A+	A−	Over 15,000,000 per Cubic Centimetre.	Under 15,000,000 per Cubic Centimetre.	A+	A−	Over 15,000,000 per Cubic Centimetre.	Under 15,000,000 per Cubic Centimetre.
	Per Cent								
19/11/34 ..	0·15	82·3	17·7	89·6	10·4	24·0	76·0	32·5	67·5
31/12/34 ..	0·20	36·4	63·6	92·9	7·1	Nil	100·0	26·0	74·0

Period ended	Graded by Acidity.	Distribution by Direct Bacterial Counts: Percentages in each Group.			
		Evening Creams.		Morning Creams.	
		Under 15,000,000 per Cubic Centimetre.	Over 15,000,000 per Cubic Centimetre.	Under 15,000,000 per Cubic Centimetre.	Over 15,000,000 per Cubic Centimetre.
19/11/34	A+	2·1	97·9	20·0	80·0
	A−	48·6	51·4	82·4	17·6
31/12/34	A+	Nil	100·0	Nil	Nil
	A−	11·2	88·8	74·0	26·0

Farm-shed Surveys.

Extensive study has been made of those conditions at farms which most urgently need attention to improve the quality of cream delivered to factories. Special surveys carried out at large numbers of representative milking-sheds have revealed many points of interest and importance and show that a very large measure of improvement is entirely feasible, in most cases without any material addition to costs. In this work special attention has been given to the collection of reliable data concerning—(*a*) The incidence of mammitis and general udder troubles: (*b*) the condition of sheds, yards, and surroundings, and of milking-machines, separators, and utensils; the facilities for washing up and sterilizing milking equipment: (*c*) attention given washing of hands, udders, &c., and the personal care exercised throughout in herd and shed management generally: (*d*) supply and temperatures of water available for cooling purposes, and the efficiency of farm cream-coolers: (*e*) the direct bacterial counts of the milk and cream at the shed, and of the same cream on arrival at the factory. Nearly all of the special surveys have been carried out on "surprise" visits. The sheds have been selected with a view to covering as wide an area as possible and ensuring that the information collected would be truly representative in all respects. The method of examining the milk for symptoms of udder trouble and the classifications adopted have been substantially the same as those used by the Live-stock Division, namely:—

Group A, normal includes milks having a body-cell count* not exceeding 1,250,000 per cubic centimetre and without characteristic mastitis bacteria.

Group B, sub-acute includes milks having from 1,250,000 to 12,000,000 body-cell count without observed mastitis bacteria.

Group C, acute includes milks having a body-cell count of over 12,000,000 per cubic centimetre with or without observed mastitis bacteria.

Samples of milk from some thousands of cows have been examined separately, and results are summarized as follows:—

Occurrence of Mammitis in Individual Cows.

Period of Investigation.	Class.	Average Percentage of Total Cows examined.
		Per Cent.
December, 1934, to April, 1935	Normal	59
	Sub-acute	25
	Acute	16

Range of Percentage of each Class of Animal found in Individual Herds.

Period of Investigation.	Class.	Range.
		Per Cent.
December, 1934, to April, 1935	Normal	23 to 98
	Sub-acutely infected	2 to 46
	Acutely infected	0 to 59

* All counts are made on the gravity cream layer of the milk-sample.

Excessive numbers of non-pathogenic bacteria were found in approximately 4 per cent. of the milks tested, ranging in individual herds from 0 to 55 per cent. No precise information is available regarding the full effects of the abnormality in milk as disclosed above, but it is reasonable to expect that total production would be adversely affected and that the natural balance of the constituents of milk would be more or less upset, with some degree of detriment to quality. It seems abundantly evident, however, that the control of mammitis is a problem of major importance to the industry. The regular testing of dairy herds appears to be the most reliable means of gauging the true incidence of the disease and of leading to universal adoption of control measures. The present investigations suggest that under-staffing at milking-sheds in many cases prevents adequate attention being given to the herd at milking-time.

The condition of sheds, yards, and surroundings has usually been found reasonably good. The visible condition of milking-machines, separators, and utensils has varied considerably: the most common faults were found to be dirty or perished rubberware, foul air-systems, and (especially where steamers are in use) the formation of milkstone deposits throughout the plant. The washing of hands, udders, &c., has not always been found uniform, even at the same shed, and wide variations have also been found in the methods employed and facilities provided for washing up and sterilizing the milking equipment. The general position from the quality point of view can be more accurately and concisely summed up by reference to the following figures:—

Direct Microscopic Counts on Milk and Cream, December, 1934, to April, 1935.

Sample.	Distribution on Basis of Bacterial Count.			
	67 per Cent. of Total Samples with Lowest Count: Average Count per Cubic Centimetre.	Remainder: Average Count per Cubic Centimetre.	Range of Counts per Cubic Centimetre.	
			Maximum.	Minimum.
		Over		Under
Individual milkers: Hand-milking and strippings	10,000	1,200,000	60,000,000	10,000
Milk in vat	333,000	5,000,000	13,000,000	10,000
Cream in cans at shed: Evening	272,000	9,000,000	60,000,000	10,000
			Over	
Cream on arrival at factory	31,800,000	259,000,000	500,000,000	1,000 000
Cream held in factory cool-room overnight	1,000,000	17,000,000	70,000,000	10,000
			Over	
Morning cream from same sheds	1,300,000	43,000,000	300,000,000	10,000

NOTE.—The counts of samples of the first of the milk drawn through the machines ranged up to 400,000,000 per cubic centimetre.

From the above figures it will be noted that in two-thirds of the special surveys a reasonably high standard of purity was found in the cream at the milking-sheds, but that exceedingly rapid bacterial development occurred overnight. It is very evident that lack of cooling of the cream was the chief factor contributing to the progressive deterioration of quality. Inadequate cooling was found to be due primarily to the capacity of the coolers being much too small in

relation to the size of the separators, and secondly to failure to make the best possible use of the fairly cool bore-water available at large numbers of sheds. The general practice of drawing water for the cooler from the outside service-tank was found to be almost useless in hot weather; and provision of a water connection direct from the pump to an efficient cooler of suitable size is usually well worth while. Water from sources other than bores was invariably found to be much too high in temperature in the summer months to permit of adequate cooling of the cream; but the percentage of sheds affected was relatively small. The following data indicate the position:—

Temperatures (December, January, and February Figures).

—	Averages.	Individual Range.
	Degrees F.	Degrees F.
Milk in vat	92	87 to 94
Cream from separator	90	86 to 92
Cream in can at finish	77	67 to 88
Water to coolers	69	61 to 77
Water from town supply or streams	74	72 to 75
Water direct from bores	61·2	59 to 64

The most striking examples of the efficacy of cooling are found in comparing the bacterial counts of samples of cream held in the cool-room overnight with the counts of samples taken from the can on the factory-stage the following day, both samples being examined at the same time. Thus original counts of under 10,000 have been found to remain under 10,000 per cubic centimetre in the samples held in the cool-room. It is recognized, of course, that equally thorough cooling and control of temperature is not yet practicable at milking-sheds. Nevertheless, allowing a difference of 3° F. between temperature of the water to the cooler and final temperature of the cream, the above figures suggest that, on the average, it should be possible in the hottest weather to cool the cream to 64° F., compared with the actual average of 77° F. recorded above. Individual losses, varying from 3° F. to 23° F., and averaging 13° F., could therefore be avoided at a minimum of cost in a great many cases. It is quite indisputable that attention to this matter alone would be of exceedingly high value to individual farmers and to the industry as a whole. It was found that a very pressing need exists for a cooler adapted for use with modern low-setting of milk vats and separators, the position of the separator cream-spout in many cases being only an inch or two above the top of a medium-size cream-can. Encouraging results have been obtained with various designs and sizes of coil coolers (constructed of tinned-copper tubing, and suspended in the cream-can), over which the cream is cooled as it flows from the separator and as it rises in the can. If the supply of cooling-water is adequate, these coolers are capable of reducing the temperature of the cream to within two or three degrees Fahrenheit of the inlet temperature of the water; and the coolers may be allowed to remain in operation after separating is finished to maintain constant temperature of the cream. In some instances installation of a small mechanical cooling-unit may be warranted; and it is expected that New Zealand manufacturers will soon be in a position to offer suitable outfits at a quite moderate cost.

In these investigations it has been observed that low initial bacterial counts apparently depend to a far greater extent upon personal standards of cleanliness and systematic attention to detail than upon the provision of elaborate facilities. Good facilities for washing up and sterilizing the milking equipment make the work much easier and certainly provide a most desirable safeguard, but the first essential is adoption of a sound routine in the cleansing of equipment. Numerous instances could be quoted to show that excellent work can be accomplished under difficult conditions, and that the personal element is very largely the determining factor in the production of sound-quality cream. Similarly, it has been found that a grave potential danger lies in the fact that in many cases the washing-up after the evening milking is of a very perfunctory nature. This may well cause quicker deterioration of the quality of the morning cream than would otherwise be the case.

Laboratory co-operation on the lines indicated above convincingly demonstrates the vital importance of (1) systematic cleanliness, and (2) thoroughly cooling the cream as it flows from the separator and of holding the cream at lowest possible temperature overnight. Laboratory work points out many unsuspected weaknesses and very often explains, in a way in which ordinary inspection quite fails to do, results that otherwise seem inexplicable. As an educational measure its merits are outstanding: it offers a feasible means of raising farm and factory instructional services to a higher and infinitely more profitable level.

As an indication of the value of laboratory assistance in farm-dairy instructional work, the following typical case is cited. The cream in question had frequently been degraded on account of what the grader could only describe as "off," "objectionable," or "unsound" flavour. Repeated inspections at the shed failed to reveal any definite cause of the trouble. The herd of eighty young cows was hand milked, and lack of cooling of the cream appeared to be the only outstanding weakness. Examination of the milk for symptoms of udder or teat trouble showed that 98 per cent. of the herd was normal, with 2 per cent. in the sub-acute mammitis class. Detailed surveys were made at the shed on the 10th and 28th of the month. Following is a summary of the results:—

DIRECT BACTERIAL COUNTS.

	Counts at 20 Hours (Samples held at Room Temperatures). Per Cubic Centimetre.
10th of Month.	
(1) Milk drawn by milker A, under 10,000 per cubic centimetre	460,000
,, B, ,, 10,000 ,,	960,000
,, C, ,, 60,000 ,,	5,100,000
,, D, ,, 480,000 ,,	6,800,000
,, E, ,, 630,000 ,,	8,800,000
(2) Cream in can at shed (evening): Cooled to 80° F., 1,500,000 per cubic centimetre	500,000,000 (Sample from can at factory.)
28th of Month.	
(1) Milk drawn by milker A, under 10,000 per cubic centimetre	120,000
,, C, ,, 10,000 ,,	190,000
,, D, ,, 10,000 ,,	370,000
,, E, ,, 10,000 ,,	1,240,000
,, F, ,, 180,000 ,, (taking place of "B").	6,540,000
(2) Cream in can at shed (evening): Cooled to 68° F., 10,000 per cubic centimetre	4,310,000 (Sample taken from can at factory.)

The above case emphasizes two points of importance—firstly, that hand milkers vary very considerably in cleanliness of operation, and, secondly, that cooling plays an outstanding part in determining the quality of the cream on arrival at the factory.

It is obvious that in seeking improvement of the quality of cream delivered to factories it is at least equally necessary to be certain that the good work of suppliers is not endangered or lost on account of faulty methods or carelessness at the factory. The maintenance of factory plant and equipment in a thoroughly satisfactory hygienic condition and prevention of reinfection of the cream and butter in the process of manufacture is not always easy of accomplishment. The high standard of keeping-quality characteristic of most brands of New Zealand butter provides some evidence that methods generally are sound. Nevertheless, a constant laboratory survey reveals how much yet remains to be done. It promptly locates any points where factory methods may be at fault, and quickly determines the success or otherwise of remedial measures. It provides the precise information that is indispensable in establishing and maintaining better control, and in respect to manufacturing details points the way to achievement of a higher and still more uniform standard of quality. Laboratory service thus protects and advances the true interests of all concerned, and its more universal adoption is worthy of serious consideration and practical encouragement.

FARMING IN THE AUCKLAND PROVINCE.

OBSERVATIONS ON FARM-MANAGEMENT METHODS.

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V. THE CENTRAL PLATEAU AND THE WESTERN UPLAND—*continued.*

ROTORUA COUNTY.

September 13th, 1935: Rotorua to Kaharoa to Te Pu. — Rotorua County consists of a high bush-clad tableland up to 2,000 ft. in elevation, broken in the lakes district by a depression with an elevation of 1,000 ft. and in the north falling in a series of broken hills to the coastal plain of the Bay of Plenty. All the land is volcanic, and the soils consist of various volcanic-ash showers and water-sorted pumice in the stream and lake valleys, and vary considerably in fertility. "A warning," writes B. C. Aston (25), "should be given against the practice of speaking of all pumice soils as a class without limitation or definition. To make general statements disparaging the pumice soils is to count disproof by hundreds of successful farmers on what may justly be called pumice lands. It is, on the other hand, dangerous to extol pumice lands indiscriminately as fields for settlement, for instances may readily be given of large areas which are not suitable for settlement by methods in common use." At Kaharoa the surface soil consists of a very coarse ash shower, the Kaharoa shower(26), which covers a considerable area of land in the Rotoiti district and extends as far as Murupara in the east, where at Galatea this coarse shower is in parts overlain by other showers. This Kaharoa shower on the bush-clad plateau round the

lakes gives a soil which is bush sick. Settlement on this land has had a very chequered career; most of the pastures consist of danthonia, suckling clover, and ragwort; streams flow in deep rocky gorges and water is scarce on the plateau—most of the drinking-water is secured from rain-water caught on iron roofs and stored in cisterns; there are a number of abandoned farms. The limonite treatment for bush sickness in sheep is proving successful, but much better pastures are required before this land can be successfully farmed. It would appear that this coarse Kaharoa shower may be too dry for white clover to grow successfully; the subsoil consists of a fine-grained shower and holds moisture well, but it is quite possible that even with top-dressing the coarse surface soil will not support a first-class rye-grass-white-clover pasture. Strangely enough, this coarse, sandy soil grows excellent swede crops. I saw

FIG. 9. LARCH PLANTATIONS, WAIOTAPU.
[*Photo by E. B. Levy.*

some of the best swede crops I have seen in the province, and the roots were still quite sound; the cultivation for the swedes had obviously been poor, for the lines of the furrow slices could still be seen, and yet all crops inspected were excellent.

December 10th, 1935: Rotorua to Guthrie Settlement and Ngakuru Blocks.—The oldest and most fertile farming-areas on the shores of Lake Rotorua are the sandy loams on the east side of the lake derived from the 1886 Tarawera eruption; farming then spread to the sandy silts surrounding the south and west sides of the lake. These soils are easily broken in and farmed. Farming has now spread south from Rotorua on each side of the main Rotorua–Atiamuri Road. Large areas have been developed for Native-land settlement, and by the Crown under the Land Laws Amendment Act, 1929. Prior to 1929 this land was a

waste of manuka, manoao, and tussock; for the 1934–35 season the developed land produced 381,573 lb. of butterfat, as well as fat cattle, lambs, mutton, and wool. The development of this pumice land has been quite successful, and with top-dressing excellent pastures of perennial rye-grass, cocksfoot, and white clover can be maintained.(27) The scrub is first cleared and burnt, the land ploughed, rolled on the furrow, double-disked, harrowed, rolled; then grass and clover seed are sown with 3 cwt. superphosphate; and after a further 6 cwt. of superphosphate has been applied, during the following twelve months, the pasture land, provided it is annually top-dressed with 3 cwt.

FIG. 10. CATTLE GRAZING YOUNG PASTURE, NGAKURU BLOCK.

The initial development of pumice country is best carried out with wethers and cattle; these quickly turn luxuriant clover-growth into manure, raise the soil-fertility, and help in the establishment of good pastures of rye-grass and white clover. [*Photo by E. B. Levy.*

superphosphate has a butterfat-production of 100 lb. to 150 lb. per acre. The usual grass-mixture consists of perennial rye-grass, 25 lb.; cocksfoot, 10 lb.; red clover, 2 lb.; and white clover 2 lb. For the first three years the dominant pasture-constituent is red clover, which if properly controlled, rapidly builds up the surface fertility and allows of the establishment of high-class rye-grass-cocksfoot-white-clover pastures. Grassing appears an easy matter; but there are certain pitfalls, and red clover, instead of building up the pasture, may destroy it—a luxuriant red-clover growth, uncontrolled, will completely smother out rye-grass and white clover. For the small settler the control of a large area of red clover is not an easy matter; he is usually engaged in dairy-farming, and milking-cows do not thrive on rank red clover—it rapidly becomes unpalatable and has to be mown and wilted before milking-cows do well on it; he has difficulty in harvesting the surplus

growth for the whole of the requirements of winter supplementary feeding—he has not sufficient labour for harvesting a large area, and often makes bad silage and worse hay from red clover through attempting too large a harvest programme. The normal alternative would be to turn to temporary pastures—and this was the old idea in developing pumice land—of Italian rye-grass and red clover before sowing to permanent grass; but it costs almost as much to sow Italian rye and red-clover pastures as it does permanent ones, and to utilize the produce from these pastures he is still forced to make the whole of the winter-feed provision with hay and silage. Fortunately, the pumice country grows good swedes, and by combining the sowing of red clover with the swede crop, it can be used to build up soil fertility

FIG. 11. DAIRY HERD, NGAKURU DEMONSTRATION FARM.
[*Photo by E. B. Levy.*

without doing any harm. The best routine for a settler breaking-in pumice land to follow is first to sow a limited area in permanent grass, containing 2 lb. of red clover, and in the same year sow an area of swedes; and, after the swedes are drilled, roll, sow 5 lb. of red clover, 5 lb. of cocksfoot, and 1 lb. of white clover with 1 cwt. of superphosphate, harrow to cover, and roll again. The division of the areas will be somewhat as follows: Allow $1\frac{1}{4}$ acres of permanent grass for grazing by each milking-cow, $\frac{1}{2}$ acre for hay and silage per cow, and 1 acre of swedes for every five cows. A cow to $1\frac{1}{4}$ acres will keep the pastures fairly well controlled, although the mower will have to be used occasionally for trimming, and a settler can usually manage the harvesting of $\frac{1}{2}$ acre per cow, and the hay and silage saved, together with the swedes, will be sufficient for winter feeding. The temporary pasture sown with the swedes is particularly useful—the red and white clover and cocksfoot do not interfere with the growth of swedes as rye-grass does—in the next

year after the swedes are eaten off, the red clover and cocksfoot plants grow luxuriantly and the produce can be made into silage. Delayed cutting does no harm, or the autumn growth can be kept over for rank feed to be grazed along with the next season's swede crop. After being down in temporary grass for two or three years the land can be ploughed and sown in permanent grass, or ploughed and sown in swedes, and, after the swedes are eaten off, disked and sown in permanent grass in the spring.

Passing from Rotorua through the Hemo Gorge, the road to Atiamuri runs for about twelve miles through Native-land development blocks; at the twelve-mile peg the Whirinaki Road leaves the main road and runs through the Guthrie Settlement and Ngakuru blocks in the valley of

FIG. 12. HOROHORO MOUNTAIN: NATIVE-LAND DEVELOPMENT BLOCK IN THE FOREGROUND. [*Photo by E. B. Levy.*

the Whirinaki River, which joins the Waikato near Atiamuri. Horohoro Mountain (2,436 ft.) makes a striking background to the Native settlement areas which nestle at the foot of its lower bush-clad cliffs, which at the top are sheer walls of rhyolite. It is remarkable how this light pumice soil has responded to good treatment, and the country promises to be good dairying and (with limonite treatment) fat-lamb raising country. Fat-lamb raising was not successful until the limonite licks were used, but for the past two seasons fat lambs have been successfully raised. Inspected this year's fat lambs on Ngakuru blocks, the lambs looked fairly well, but are not as early this year as last, owing to a long spell of cold wet weather in November which took the bloom off and put the lambs back there will be a number of cull lambs. Fat-lamb raising, if it continues to be successful, is going to help tremendously in the development and farming of this country,

which fattens cattle well; but cattle are not nearly as profitable as sheep. One looks for a gross return of about £1 10s. per annum from a cattle beast, but a ewe for fat-lamb raising will return £1, and four ewes can be carried for each head of cattle. Well did Fitzherbert remark that "shepe is the moste profytablest cattell that any man can have." The initial development of the country can be best carried out with wethers and cattle: these quickly turn the luxuriant clover-growth into manure, raise the soil-fertility, and help in the establishment of good rye-grass and white-clover pastures. Even rye-grass and white clover do not entirely satisfy dairy cows, and I was interested to watch the work a herd of fifty dairy cows, grazing rye-grass and white-clover pastures, had done in cleaning up a rough face of grass, fern, and manuka: the cows would spend an hour on the good grass and then migrate across a creek and up a very steep face to get at the roughage.

WAITOMO COUNTY.

November 22nd, 1935.—Te Kuiti, Piopio, Mairoa, Marakopa.—Waitomo County is a county of contrasts, containing as it does areas of well-cultivated prosperous farms and areas of deteriorated hill country. The road followed crosses the limestone and sandstone hills to the west of Te Kuiti, follows the valley of the Mokau River to Piopio (400 ft.), then climbs the limestone hills to the Mairoa Plateau (1,100 ft.), and thence over the greywacke Herangi Range (Maungamangero, 2,656 ft.) to the valley of the Kiritehere Stream, and follows the coast to Marakopa. The hills near Te Kuiti are generally in clean pasture, with here and there patches of gorse and bracken fern; blackberry is giving trouble on some farms, and goats are being used for control. Towards Piopio I passed on the road quite a number of small lots of ewes and lambs, evidently being taken to dairy-farms for the control of ragwort, which is now beginning to grow luxuriantly. On the light undulating hills in the valley of the Mokau there is quite a fair amount of cultivation work being done—generally land being prepared for swedes. Near Piopio I examined a spring-sown pasture which had followed last year's swede crop. The general strike of grass and clover was only moderate, but the strike was quite good on the cartage tracks through the field, where consolidation was good; no roller had been used prior to sowing. Bracken fern was coming fairly strongly in the spring-sown grass, which was not throwing sufficient feed to allow of the crowding on of stock to crush the young fronds in the curl stage. Autumn sowing is the best for bracken-fern control, for the bracken is dormant in the winter, and autumn sowing allows the grass to become well established so that it provides sufficient feed for the crowding on of stock to crush the young fern fronds.

Rising from Piopio to Mairoa the country shows considerable signs of pasture-deterioration; pastures have deteriorated to bracken fern, manuka, and hard fern, and at Mairoa, where on many farms trouble has been experienced in running sheep, ragwort is plentiful. Here considerable work is being done by camps of unemployed men in reconditioning deteriorated farms for settlement under the small-farm plan. The old pastures consist of sweet vernal, danthonia, Yorkshire fog, ragwort, suckling clover, self-heal, broad-leaved plantain, and piripiri. The easy-ploughable land is being logged up, ploughed,

cropped, and resown to grass. The soil consists of a light volcanic ash shower, the rainfall is very heavy, and the land will require regular and liberal top-dressing if a reasonable pasture turf is to be maintained.

Passing from Mairoa to the Herangi Range, hill-country deterioration becomes quite common. The flats and easy slopes are in quite fair grass, but up the hills the turf weakens, danthonia, brown-top, sweet vernal, and a little suckling clover make the sward, bracken fern and manuka cover large areas. Where bracken fern has been crushed out hard fern occupies a lot of land, and up on the ridges where stock have moved and camped the grass sward is again quite fair. Bracken fern and hard fern give place to one another on this class of country, depending on management. Most of the bracken-fern areas have gone through a phase in which hard fern previously existed; a smother of bracken fern for several years will shade out hard fern, but if the bracken is then crushed out while any hard fern remains there is a return of hard fern.

Manuka, bracken fern, and hard fern are best dealt with primarily by burning and resowing, and subsequently by stocking and top-dressing. Manuka areas should be cut, and, with light scrub, cutting should be delayed until four or five weeks before firing. Hard fern presents difficulties, for it requires a very hot fire to kill the rhyzomes; spraying with arsenic pentoxide has proved a satisfactory method, but it entails a great deal of labour.(28) The general mixture(29) for secondary burns consists of—Perennial rye-grass, 8 lb.; crested dogstail, 4 lb.; brown-top, 2 lb.; *Danthonia pilosa*, 3 lb.; white clover, 1 lb.; *Lotus major*, 1 lb.: total, 19 lb. per acre. In logging-up burns, or on secondary burns where a good deal of timber is burnt, 4 lb. of cocksfoot may be added to the mixture; on hard country 3 lb. Chewings fescue and ¼ lb. of yarrow may be added, and the rye-grass and crested dogstail reduced. The aim of the mixture is to give a quick cover with rye-grass and white clover, thus giving feed to enable bracken to be crushed out with cattle, and, as fertility falls, brown-top, danthonia, and *Lotus major* form a sward. Perennial rye-grass establishes rapidly, and, while there remains a certain amount of ash, throws quite good feed. White clover establishes well, but if the land is not top-dressed it goes out after about three years. Brown-top forms a good and cheap cover. Danthonia is slow to establish and produces very little feed for the first three years. Crested dogstail establishes well and carries on the pasture between the going-out of the rye-grass and the coming in of danthonia. *Lotus major* is slow to establish, but produces well after the third year.

After a wet month, the past two days have been fine and all farmers are busy shearing. Piripiri is common on all pastures, and early shearing is needed to get clean wool. This year it is going to be a race between the shearing and the ripening of the piripiri, the heads of which are all ready to ripen with a few days' warm hot weather. At the coast there is a good deal of clean hill country in danthonia, ratstail, and paspalum. Here the climate is warm enough for ratstail and paspalum, and the rainfall is lower than farther inland, and hard fern is not as troublesome.

KAWHIA COUNTY.

September 22nd, 1935: Marakopa to Te Anga.—There is some good land in the valley of the Marakopa River, while the hill country is very similar to that in Waitomo County, the pastures being fairly clean near the coast, but reversion becoming common as one ascends to the Western Upland. Visited a farm near the coast in good clean hill pastures that the farmer was intending to top-dress. Up to ten years ago only cattle were carried on the farm, and the pastures were mainly rye-grass, cocksfoot, and white clover; ten years with breeding ewes, giving close winter grazing, has thinned out the pastures and the main sward consists of danthonia, brown-top, and suckling clover. Rye-grass and white clover still persist as small plants, and top-dressing should increase pasture-production. Up to the Western Upland past Te Anga I inspected a secondary sowing on a manuka burn that was sown last March. The strike was poor, and it looked as if very heavy rain had washed most of the seed and ash down into the valleys. The pasture was not throwing sufficient feed to enable the bracken fern, which was coming back, to be properly controlled. When a secondary sowing fails, it is not worth while expending further money in seed and fertilizer in trying to thicken up the sward. The only thing to do is to make what use is possible of the feed produced, and when the land has again reverted try another secondary sowing. Last season was a bad one for secondary sowings: the weather was very hot and dry in January, February, and early March, and the rain when it did come came in heavy thunder showers which washed down the hills rather than soaked in. From the top of the Western Upland one can see right across the country to the north, east, and south—can see Pirongia, Maungatautari, the Rangitoto Range, Tongariro, Ngauruhoe, Ruapehu, and Egmont, and the great extent of country that forms the Western Upland and the Central Plateau. Much of this land should be permanently forested, for land with a high elevation and a heavy rainfall is difficult to maintain in grass.

December 12th, 1935: Pirongia to Te Rauamoa.—The road from Pirongia to Te Rauamoa passes through four counties—viz., Waipa, Raglan, Otorohanga, and Kawhia. Te Rauamoa (1,200 ft.) is situated on the Westland Upland on the spurs of Mount Pirongia. Originally bush country, the land was grassed after surface-sowing. The climate is very wet. A great deal of the surface-sown grassland has reverted to fern and manuka. There has been a fair amount of grassing after logging up and ploughing, but the pastures obtained are not particularly good, consisting of danthonia, sweet vernal, Yorkshire fog, broad-leaved plantain, catsear, moss, and suckling clover. Piripiri is very troublesome even on the pastures sown on ploughed ground, and lambs covered in the ripe heads looked rather miserable. Inspected a pasture that was sown after ploughing in the autumn of 1930—rye-grass, 20 lb.; cocksfoot, 12 lb.; dogstail, 3 lb.; timothy, 2 lb.; white clover, 2 lb.; red clover, 3 lb.; and *Lotus major*, 1 lb.; sown with 3 cwt. superphosphate and parts with 25 cwt. of lime in addition, and top-dressed with 2 cwt. to 3 cwt. superphosphate for three years. Most of the pasture consisted of rye-grass, white and suckling clover, with a strong addition of fog, cocksfoot, sweet vernal, moss, catsear, and broad-leaved plantain. Where the land had received both lime and superphosphate

the white clover was much stronger than where it had received superphosphate alone. Piripiri was very strong all over the field, and on this country it seems to be very difficult to deal with. Ragwort used to be troublesome here, but is now not much in evidence. This land can be successfully grassed only with a very high farming, and this is not really profitable on steep land at a high elevation, in a very wet climate; much of the steep country will eventually go back to forest.

References.

(22), (23), and (29) E. B. Levy: Grassing Experiments on Hill Country in Whangamomona County. This *Journal*, October, 1931, and February, 1932.
(24) B. C. Aston: Control of Bush Sickness in Sheep. This *Journal*, June, 1932.
(25) and (26) A Reconnaissance Survey of Pumice Soils. This *Journal*, January, 1925, and June, 1926.
(27) P. W. Smallfield: Pasture Establishment on Pumice Lands. This *Journal*, March, 1934.
(28) Levy and Madden: Hard Fern Control by Spraying with Arsenic Pentoxide. This *Journal*, March, 1932.

VINE-CULTURE UNDER GLASS.

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The purpose of this bulletin is to help beginners by giving information, necessarily somewhat general, about how grapes should be grown. It is not intended to deal with the many variations in method of training, &c., these being merely adaptions of certain principles which are described. A plan for a vinery is not included, it being considered that as one plan would have but a very limited application its inclusion would not serve a sufficiently useful purpose.

Grapes can be and are grown successfully in glasshouses of many kinds, and provided certain general principles are observed there is a reasonable prospect of success. In some cases pot-plants are grown in the same house as the vines, but only in rare instances does this make a good combination. If, however, the house is so built that there is a good deal of glass not obscured by the vines the plan may be successful. When this practice is in vogue the pot-plants should be a secondary consideration, and treatment should be given for the vines just as though there were no pot-plants. The vine requires a fairly moist atmosphere, and a border suitable for good development of roots.

Situation.

The vinery should be built in a position that will secure the greatest possible amount of sunshine. In some places it is not possible to so place the building that it will get the sun from sunrise to sunset, hills or tall trees being in the way. Where a choice is possible in such cases the early morning sun should be preferred to the evening rays. The ventilators should be closed before the sun leaves the roof; the temperature will then rise and a fair degree of warmth be maintained far into the night. It is after midnight that the heaviest fall in temperature takes place. The earlier the warmth can be secured the

better, and so the early morning sun is more valuable than that of evening. In places where the configuration of the land is such as to give the benefit of both morning and evening sun the fall in temperature is of short duration. In such places grape-growing is comparatively easy, and early ripening takes place.

Description of Vinery.

The span vinery (or, as some term it, the ridge vinery) is most economical because there is no waste back wall. For an open situation this is the best form. The general dictum is that such a house should run north and south. In this position the sun rises on one side and sets on the other. There is abundant evidence, however, that, at any rate in the warm climate of northern districts, it makes practically no difference which way the vinery faces, and it may be built in the position which is most convenient. The side walls should not be less than 4 ft. high. A lesser height than this, unless the angle of the roof be sharper than is necessary or advisable, will make the working of the vines very inconvenient. Side walls are frequently built up of solid material, either boards or concrete, though the present tendency is to make them partly or wholly of glass. Use of glass is much to be preferred, though a little more expensive.

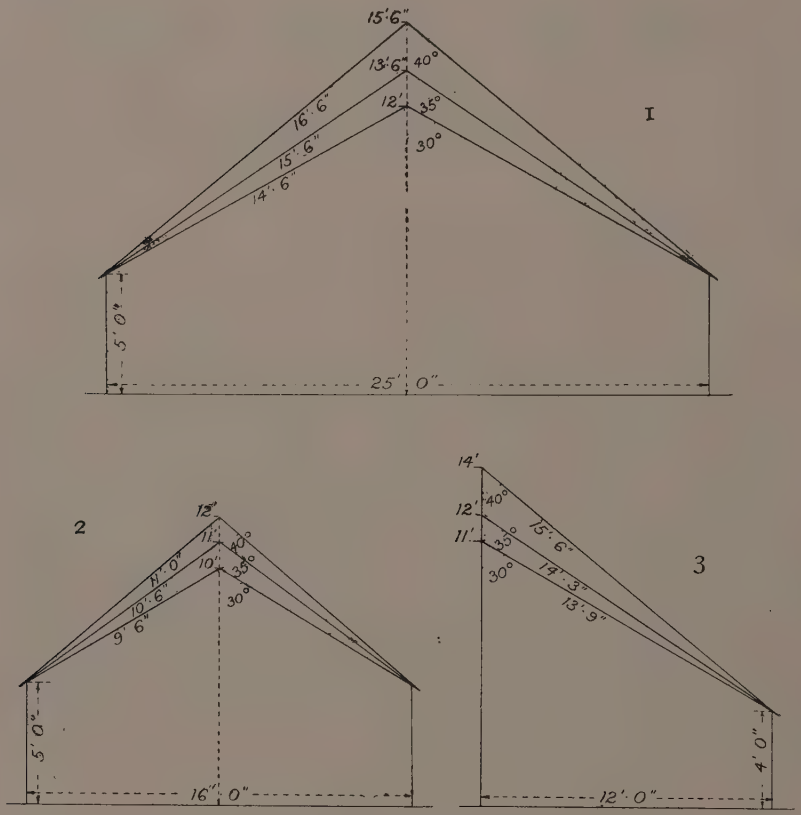
A lean-to house should face north-west, with a little variation one way or the other as surrounding conditions may render advisable according to the factors referred to under the heading "Situation." The front wall will be the same as for the span house. The lean-to with a roof pitch of 45° is the best form of house for the production of early grapes where artificial heat is employed. For other than early houses a pitch of 30° to 40° is ample. A lower pitch than 30° should be avoided, except in a very dry climate. In rainy climates a fair pitch is necessary to secure a proper movement of the air and to avoid a stagnant atmosphere, so that 35° or 40° would be better than 30°. The accompanying diagrams explain the application of the different angles mentioned. The lower the pitch the lower becomes the height of the end walls, and consequently the expense of building is reduced.

Ventilation should be ample, particularly at the top. Good bottom ventilation is also required in the warmer parts of New Zealand. In the case of span vineries ventilators should be placed in each end of the house, and in the case of lean-to houses in the back wall always as near the apex of the roof as possible.

Size of Vinery.

When the cost of the building is compared with the value of the crop it accommodates it will be recognized that a very small vinery is the one that will give the lowest proportionate return. On the other hand, very large vineries are not economical, as the extra strengthening required is costly. The following statement on this matter by a well-known English authority is of interest: "Probably there are more vineries built 25 ft. or 30 ft. wide for market purposes than any other width, though houses 15 ft. or 16 ft. wide are common, and vines do very well in them." Above 30 ft. wide, houses tend to become unwieldy, and the expense of building is considerably increased. Most of our leading

nurserymen have at some time or other gone in for building giant glass-houses, but in nearly every case when building further houses they have returned to the smaller sizes. In the same way the length of a vinery should not exceed 200 ft., as excessive length creates difficulties in the keeping-up of uniform temperatures in all parts of the house, and also in ventilation, and even in the working of ventilators themselves. At Worthing, England, the favourite size seems to be 160 ft. long by 25 ft. or 30 ft. wide. In the north of London the vineries run somewhat longer, especially in the large nurseries, 200 ft. being the most common. From all points of view the most workable size is the Worthing standard.



SECTIONS OF VINEHOUSES, SHOWING PITCH OF ROOF, ETC.

Fig. 1. Span-roofed house, 25 ft. wide, showing height at centre, and length of rafter at angles (from the horizontal) of 30°, 35°, and 40° respectively. If the side walls are built 4 ft. instead of 5 ft. high, as is commonly done, the height at centre will be 12 in. less.

Fig. 2. Span-roofed house, 16 ft. wide, with side walls 5 ft. high, showing height in centre, and length of rafter at angles of 30°, 35°, and 40°.

Fig. 3. Lean-to house with front wall 4 ft. high, showing height of back wall, and length of rafter with roof pitched at 30°, 35°, and 40°. Note.—It is often convenient to gain head-room by lowering the floor, thus saving in height of wall.

The Trellis.

Wires for training and support of the vines are preferably fixed vertically, No. 12 galvanized wire answering this purpose. Long screw-eyes, or other suitable supports, should be fixed to each rafter, these being long enough to keep the vine-rods 18 in. from the glass; one wire to attach the vines and one in between the vines to tie the laterals to. One of the most frequent mistakes is training the rods too close to the glass. The leaves and sub-laterals occupy the space between the rods and the glass, and if there is not plenty of room the leaves press against the glass. Moisture that collects during the night is not then readily dispelled, and remains until evaporated by hot sunshine. The result is scalded leaves and, frequently, attacks of mildew. There should be a clear space between the leaves and the glass: This allows a free current of air to pass between them, so that moisture is quickly dispelled and the leaves function properly. Good grapes cannot be grown unless there are healthy leaves.

The Border.

The soil used should be of a moderate depth and of such a character that the roots are able to work freely in it. If drainage is naturally good so much the better; if not, good drainage must be provided. The spouting should be fixed to catch the rain that falls on the roof of the house. This is not of great consequence during summer-time, except possibly during heavy downpours, but in winter, when the greatest amount of rain falls, if there is no spouting the soil close to the building becomes sodden, cold, and stagnant, and cases are known where the roots have been killed, and the vines have died from this cause. Water from the spouting should be led into the drains, or at least to a position where it can get away readily from the border.

In some cases private vineries are built and planted with vines in unsuitable soils, which sometimes are very little better than a poor clay. A prepared border is necessary in such cases to obtain satisfactory results, the best material for the purpose being the top spit from an old pasture. The site should be excavated to a depth of at least 30 in. Where drainage is necessary the pipes should be placed 6 in. deeper at the foot of the border. The method of filling is to cut the turves about 3 in. thick, placing them as cut with the grass side down. When a layer of the turves has been placed, cover with a layer of loose crumbs of the same soil, which will close up interstices. Over this apply a dressing of carbonate of lime about ½ in. deep, together with bone-meal at the rate of 2 oz. per square yard. Continue in this way until the excavation is refilled, finishing with about 6 in. of loose soil into which the same amount of lime and bone-meal should be worked.

For commercial purposes the house should be built where the soil is of a suitable character. Trench to a depth of 36 in. at least. Arrange the trenching so as to leave the topsoil still on top. During the trenching of the soil apply lime and bone-meal, as with the made border, to a total amount of ½ lb. of bone-meal per square yard, to be mixed with the soil as trenching proceeds.

Assuming the soil and other conditions to be suitable, the best site for the house is on an old pasture. Where the outside border is level with the floor of the house, it is better to plant the vines inside the house, in which case the border should extend to about 2 ft. inside the walls, which should be built with arches so as to allow the roots to extend into the outside border, which they invariably do. The roots always go outside to the sun when they can do so; therefore all that is required inside is just sufficient border room for planting. In cases where the roots are to grow inside the house—this being preferred where the vines are forced, as watering is under control and the soil is warmer—the whole of the space should be trenched in the same way as recommended for outside borders. In some cases the site chosen may be low or the subsoil wet. It is then advisable to cart soil to raise the borders. On slopes it may be necessary to lay drains to cut off excess water that would reach the borders by seepage. It always should be borne in mind that a sweet rooting-medium is of vital importance. A dry border can be watered; if it becomes too wet remedial measures should be resorted to.

Planting.

The vines should be grafted on phylloxera-resistant stocks. The unions of grafted vines should be at least 2 in. or 3 in. above the ground when planted. If planted so that the union or part of it is below the surface of the soil, the scion throws out roots and ultimately the stock perishes. After planting, soil should be mounded up to several inches above the union, so that when the soil settles down the union will still be covered. This earth should be removed in January and any roots from the scion cut off. The earth is then replaced and removed finally in the autumn. The unions of aerial grafts such as the yema or bud-graft and green-grafts do not require mounding up. Before planting, the vine should be pruned, leaving two to four buds (see statement regarding first year's training). Any roots that may be damaged should be shortened back beyond the injury. A broad hole 6 in. deep is then made, the roots spread out on the bottom, and the soil returned and treaded firmly. If the soil has become dry the vines may be watered in. July is a good time to plant.

The correct distance apart for the rods is determined partly by the habit of the variety and partly by the purpose for which the vines are planted. When grapes are grown for private consumption there is a very natural desire for extra-fine fruit and large bunches. It may be said here that most if not all of the older standard works in vine-culture have been written for the purpose of showing how to grow fine grapes. The commercial aspect has either not been considered at all or the systems recommended have been based on the supposition that fine bunches are of equal value for either purpose. The fact is that as a rule the commercial grower does not wish for large bunches. Three 1 lb. bunches are more useful to him than one bunch weighing 2½ lb. or 3 lb.; in fact, he wants a heavy crop of rather small bunches. In obtaining this kind of crop it is likely that the quality may suffer somewhat, but with

good management fair quality can be secured, and the heavier crop will more than make up for a slightly lower price per pound. This explains, at least in part, why commercial men with experience allow more than one bunch to each lateral, which is the maximum usually recommended.

For commercial purposes the rods of Black Hamburg, which is the principal variety grown, and of similar varieties of the sweet-water group of varieties, should be 30 in. apart. More strongly growing varieties, such as Gros Colman, Gros Maroc, and Alicante, should be 36 in. apart. In private houses these distances are, for reasons already explained, increased to 4 ft. and 4 ft. 6 in.

DISTANCE BETWEEN PLANTS.

It is well known that vines succeed best under the extension system, under which the historical specimens have been grown. The Hampton Court vine—planted in 1769—occupies a house 66 ft. long and 30 ft. wide; it produces some 1,700 bunches annually. The old vine at Cumberland Lodge, Windsor Park, occupies a house 138 ft. long and 20 ft. wide, and ripens about 2,000 bunches of grapes. Another at Kinnell House, Breadalbane, Scotland, fills a house 172 ft. long by 25 ft. wide. The leviathan of vines in England is that at Manressa House, Roehampton. Planted in 1862, it occupies a house 224 ft. long. It ripens from 600 to 800 bunches annually, some of which weigh between 3 lb. and 4 lb. The Manressa vine is growing in the natural soil of the situation—a free clayey loam.

Free extension leads to long life in the vine, its vigour being maintained by that system. Such a system, however, is not suitable for a commercial house, as it takes too long to fill a house. Restricted growth is necessary for this purpose, and is generally adopted also in private establishments, a greater number of vines being planted so as to fill the space quickly. Practice varies in so far as some growers allow each vine to make two rods and others only one. The general opinion is in favour of two rods, although one rod answers very well provided there is a long rafter, say, not less than 16 ft. Where the rafter is shorter than that the vines should have two rods. Vines with a very short run weaken sooner than those that are less restricted. Two rods can be worked up from one vine as quickly as one, but a larger number would take a longer time, as only two can be worked up simultaneously. Cases are known where vines growing in narrow span-roofed houses are trained up one side and down the other. It would be far better to plant on each side and allow two rods to each vine. Where the situation is such that a border can be arranged on one side only, the trellis at the apex of the roof should be fixed as low as convenient so as to reduce the curve of the rod as much as possible.

It has been stated earlier that planting inside the house is the better. There is no obstacle to this if the building is of wood, but where concrete foundations and walls are erected it is not convenient unless the wall is built in arches. Outside planting answers nearly or quite as well, holes being left in the wall to lead

the vines through. In this case it is advantageous to plant vines with rods long enough to reach into the house, the young vines being pruned to that length. Some growers plant the vines a year before building the house, there being then no difficulty in getting a rod or two to reach to the inside. When the vines are planted inside the house they should be cut down to two buds.

The distance apart at which to plant depends on the number of rods to be allowed. If two rods are trained up, then there is required only half the number of vines that would be necessary if only one rod were allowed. If single-rod vines are to be grown at a distance of 2 ft. 6 in. apart, then the end vines should be planted 15 in. from the ends of the house, and the remainder 2 ft. 6 in. apart. If two rods are to be grown, then the end vines should be 2 ft. 6 in. from the ends and the others 5 ft. apart. The end rods should be trained up 15 in. from the end of the house, the rods throughout being 2 ft. 6 in. apart.

Training the Vines.

The developed vine consists of one or more rods. Alternately arranged on either side of a rod are processes termed "spurs"; these are spur-like projections caused by cutting back the side growths. The growths that proceed from the spurs are termed laterals. During the season of growth side shoots come from the laterals, these being termed "sublaterals." From various parts of the growing lateral, and sometimes from the upper part of the stem of a bunch, there are formed leafless processes with spirally twisted ends; these are the "tendrils." When a young rod is being formed its extremity is termed the "leader." Both laterals and sublaterals are formed on young growing rods as well as on old rods, but in the former case they are, of course, of later growth, appearing as the leader lengthens. At each joint—*i.e.*, where a lateral issues from the main rod—there is a leaf on the rod, and at the base of each leaf there is a bud which produces a lateral the following year. The leaf and the bud which develop on the rod do not persist after the first time of bearing fruit; both buds and leaves then arise on spurs formed by the shortening of the first bearing-laterals.

Leading Vines into the House.

Where the vines have been planted two years before the erection of the house and have made good rods they should be able to produce a few bunches of grapes the first season following the erection of the house. If the vines have been planted only one year, then at pruning-time sufficient length of rod should be left to reach into the house—that is, supposing the house has been erected so as to leave the vines outside. In such cases, whether it is intended to work up one rod or two rods to each vine, only one rod should be taken in. If, however, the house is built over the vines two rods may be left if desired, provided they have been secured in the right position. In either case the one-year-planted outside vines will require the same training as those newly planted

inside the house. Those having a year's start should, however, make more growth than those newly planted.

In the case of vines planted outside after the house has been erected, a strong growth should be selected for leading into the house. This should in the first place be secured to a strong stake inserted in the ground at an angle so that it will be led to the aperture left for its admittance to the house. As soon as the point of the young rod reaches the aperture it should be led in, and, when sufficient growth is made, tied to a stake leading to the bottom wire. If the vine is to have only a single rod it should, on the young rod reaching the wire, be led straight up the roof ; but if the vine is to have two rods the tip should be pinched off so that the two laterals nearest the top will form the rods, these being trained horizontally for the correct distance and then led up as in the case of the single rod.

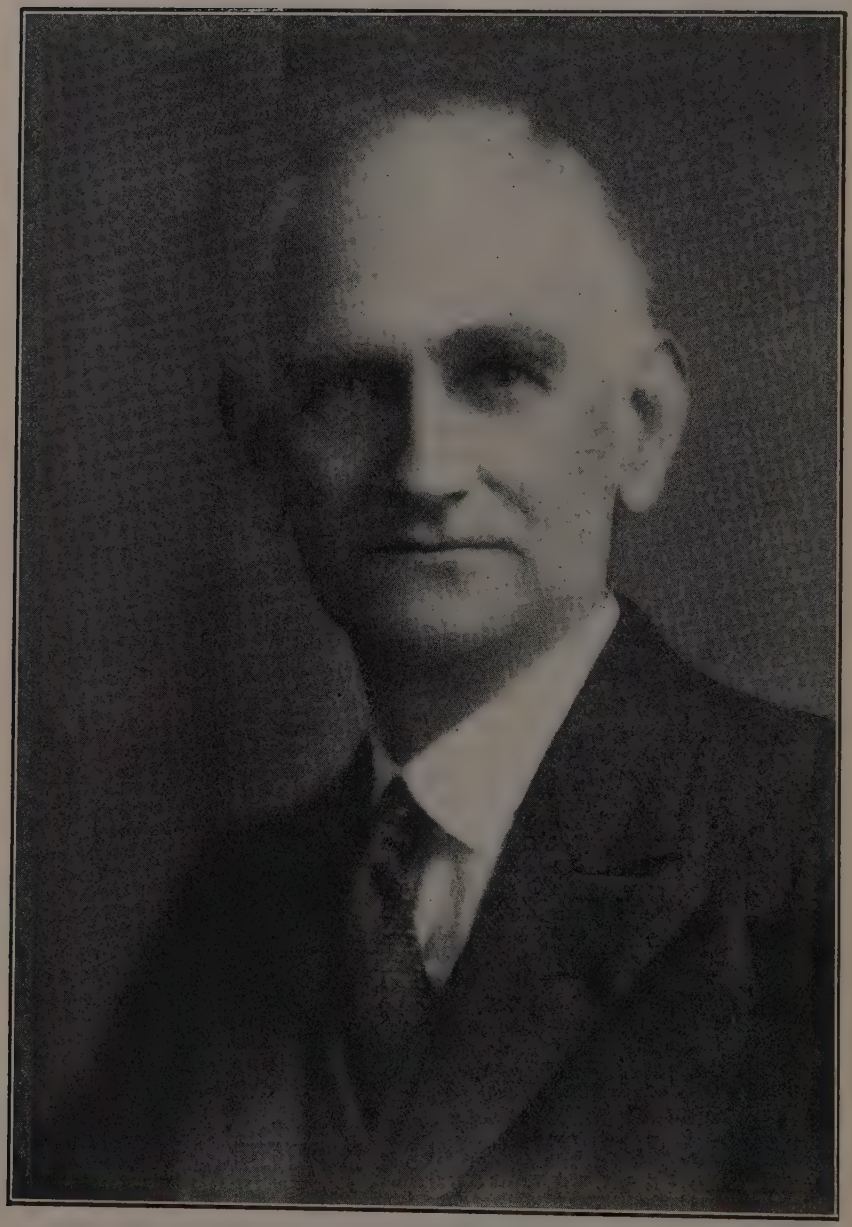
Establishing Strong Plants.

The firm establishment of the vines is the first care of the grower. This is secured by inducing the vines to make a vigorous growth, which in turn causes the formation of a proportionate amount of root-growth. When borders are well filled with healthy roots good lateral growth in after-years can usually be counted on. In former times it was customary, after the first season of growth, to cut the young vine back to within a bud or two of its base ; but this plan has now been generally abandoned, and with a view to bringing the vine into earlier bearing a length of 3 ft. to 4 ft. or more of the young rod is left. In carrying out the former plan the growth made during the first season was allowed to go almost unchecked, with merely a pinching of laterals here and there to prevent overcrowding. This will not answer in modern practice.

It is necessary to deal with growth in a systematic manner, for it is the nature of a vine to make its strongest growth at the top. The farther the vine reaches the greater is the strength of the top growth as compared with growth on the lower part of the rod. In fact, the top growth robs the bottom growth of sap. When a certain length of the young rod is to be left some restriction of growth is necessary, or the lower buds will be left very weak. It is well known that the lower spurs often produce very poor bunches, while the best bunches are usually borne on the upper half of an established rod ; the natural tendency is always in this direction. The difference is most marked when a rod has been forced up too quickly, and is further accentuated by neglect to control growth during the active period of the first season.

(To be continued.)

An order of the Ministry of Agriculture, London, England, prohibits the landing in England and Wales of any living parts of plants (except the seed) of sugar-beet and mangel from abroad, except under license from the Ministry, and requires certain prescribed certificates, except in the case of a consignment consisting wholly of potatoes, to include a statement that the consignment does not contain any plant of sugar-beet or mangel. The object of the order is to prevent the introduction to the United Kingdom of virus diseases which have proved injurious to the sugar-beet industry on the Continent.



MR. A. H. COCKAYNE, RECENTLY APPOINTED DIRECTOR-GENERAL OF THE DEPARTMENT OF AGRICULTURE.

A. H. COCKAYNE APPOINTED DIRECTOR-GENERAL OF AGRICULTURE.

MR. A. H. COCKAYNE, Assistant Director-General since 1929, has been appointed to succeed Dr. C. J. Reakes as Director-General of the Department of Agriculture.

Because of the economic, technical, and scientific developments of recent years, numerous important, novel, and complex problems promise to be associated in the future with the rural industries of the Dominion. Many of these problems fall within the sphere of work allotted to the Department of Agriculture, and so Mr. Cockayne, in taking over the reins in the Department, becomes responsible for providing a public service of considerable and increasing moment in our national economy. Mr. Cockayne brings to this task a remarkably thorough and broad knowledge of the practices and problems of the farming of New Zealand. Indeed, his knowledge is so outstanding in its extent and wealth of detailed information that it is recognized by his co-workers to be unequalled.

Some measure of the encyclopædic character of Mr. Cockayne's knowledge of farming is provided by his contributions to the *Journal of Agriculture*, in the first number of which, published in 1910, he dealt with aspects of our tussock grassland. Since then he has contributed articles on such widely diverse matters as spraying-oils, weed-control, insect pests, plant-breeding, seed-testing, shelter-trees, plant-diseases, sources of honey, seed-production, mineral content of pastures, costs of work by tractors and by horses, the structure of wool, and the feeding of dairy cows.

Pastures greatly dominate New Zealand farming, and the better-class New Zealand farmers are in the van, when compared with the better-class farmers of all countries, as regards their results in profitable pasture-production and pasture-utilization. The eminently satisfactory standard of our grass-farming may be attributed largely to the pioneering work of Mr. Cockayne, and to the inspiration and guidance he has given subsequently to other grassland workers. Incidentally, during recent years Mr. Cockayne, far from holding that our present standard of grass-farming is fully satisfactory, has been a persistent and strong advocate of the need not only for more knowledge, but also for more effective application of the current knowledge.

Latterly, as Assistant Director-General, Mr. Cockayne has greatly extended the sphere of operation of his energy and insight into many major matters connected with our sheep-farming, pig-keeping, dairying, and horticulture. Hence he comes to his present position peculiarly well equipped with knowledge of the widespread ramifications of the Department of Agriculture. The somewhat popular association of the Public Service with stereotyped outlook and methods gives interest to the fact that Mr. Cockayne has not exhibited any tendency to overvalue routine procedure or orthodox opinion.

Mr. Cockayne's faculty of critical analysis has made him aware of the need of improvement and progress in our farming. His originality and constructive imagination combined with his ability to

provide strong word-pictures of his ideas has made him at times a fighting prophet of new views. In short, his past work provides evidence of capacity for particularly progressive intelligent leadership.

Mr. Cockayne's career has many interesting phases. Undoubtedly he owes much to the influence of his eminent father, the late Dr. Leonard Cockayne, C.M.G., F.R.S., who was a world leader in the sphere of botany in which he specialized, and who has passed on to his son the ability to assess accurately the relation between scientific data and practical affairs, so that conflict between theory and practice is avoided.

After attending Canterbury University College as a student, Mr. Cockayne became assistant demonstrator in biology under Dr. Dendy. His service in the Department of Agriculture commenced in 1904, when he became assistant biologist, the late Mr. T. W. Kirk then being biologist. Mr. Cockayne was biologist from 1909 to 1921, when he became Director of the Fields Division. In 1927 be became Director of the Plant Research Station on its establishment, and continued as Director of the Fields Division. In 1929 he became Assistant Director-General, retaining the directorship of the Plant Research Station.

THE WINTERING OF HOGGETS.

J. E. McIlwaine, Veterinarian and Animal Husbandry Officer, Department of Agriculture, Palmerston North.

The successful wintering of hoggets with a minimum of losses is a branch of sheep-farming which requires some considerable skill, experience, and knowledge of sheep-husbandry which may be little known to those farmers normally well versed in other aspects of sheep-farming. Some men make a special feature of wintering hoggets, whereas others wish to have nothing to do with it, and others, again, are compelled to winter a certain percentage of their later lambs. Stud-breeders, as a rule, make a special effort to carry over their hoggets safely and generally are very successful. Success or failure in dealing with this branch of sheep-farming is of special importance in a season such as farmers are experiencing at the present time. The great contrast between the past season and the previous one requires to be given due consideration by all farmers who are interested in the wintering of hoggets. The heavy rainfall throughout the recent summer and autumn has resulted in an abundant growth of feed for sheep in all parts of the North Island. Many farmers, and especially those engaged in the wintering of hoggets, would prefer a drier season, especially during the autumn months. It is generally accepted that young sheep do better on a drier, more fibrous feed than that at present available. This is confirmed by the experience of those who specialize in fat-lamb production—although there was an abundance of feed for both the ewe and lamb the killing season for lambs was this year later on account of the lack of finish and bloom on the early lambs sent forward. From this evidence it will be seen that the nature of the

season and the feed produced play an important part in the raising of young stock. There is no doubt that more difficulty is experienced in an exceptionally wet season with an abundance of feed than is the case in a more normal season. Farmers have been well advised to adopt precautionary measures in such a season to prevent undue losses later on.

The great majority of sheep-farmers has long recognized the important part played by cattle in the control of their pastures so that the sheep, which grazes more closely, may get the young leafy and more nutritious herbage. In an abnormal season such as the present one many farmers have experienced difficulty in getting enough cattle to control the coarser stronger growth of pasture.

This is a branch of stock-management which is difficult to foresee and judge correctly in the early part of the year, as too many cattle could easily be used in a season of drought. It is therefore of prime importance that each farmer should take stock of his own position and of the condition of his hoggets before the season becomes further advanced. Many have done so already, as evidenced by the large number of inquiries which have been received. There are others, however, who may not have given the due consideration to the special conditions which now apply.

As a rule, the dairy-farmer who buys a few cull lambs experiences little difficulty in successfully carrying them through the winter. One might well ask the reason why. It will be obvious in this case that one of the important reasons for his success is that the lambs are placed on well-grazed and well-controlled pastures, pastures which have been eaten down by the dairy herd. Another important reason is that such pastures have not been stocked with sheep throughout the season and are not fouled or "sheep-sick" and are free from parasitic infection. A further feature of the success lies in the fact that only a few lambs are carried and that a free range and great variety of feed are available and that overstocking is not a factor in such cases.

The sheep-farmer who is wintering a large number of hoggets has not such favourable conditions; in fact, in many cases he has to meet the very opposite conditions to those of the dairy-farmer as just described. His pastures may have "got away" in a season like the present one, he may be understocked with cattle through sheer inability to obtain sufficient for his requirements, his pastures may be "sheep-sick," and, owing to a shortgage of cattle, he may have stocked heavily with sheep, resulting in fouling of his pastures and a heavy infection in regard to parasites. Careful shepherding of hoggets is therefore very necessary to detect those which are not doing well, when immediate steps require to be taken to overcome the cause of the trouble. Unsuitable feed conditions with a heavy infestation of worms undermines the constitution of the hoggets, resulting in coughing and scouring and, on occasions, a serious mortality. A harshness and openness of the wool develops, and if the affected hoggets are examined more closely it will be found that the skin is pale and the animals are in poor condition.

Those most seriously affected should be segregated and dosed with a suitable worm-medicine and given a change of pasture as outlined above. Many farmers will have such crops as rape, chou moellier, and barley available for this change of feed, and many will use roots, silage, and hay later on. Feed of this nature will be comparatively free from parasitic infection and, if suitable worm-medicine has been used in conjunction with feed of this nature, good results can be expected. Many depend almost exclusively upon pasture, and here considerable judgment is necessary to use the best-drained paddocks and the least-contaminated paddocks for the hoggets. If silage and hay have been saved for winter feeding the aftermath paddocks will provide clean pastures until the silage and hay can fill the gap. A rising plane of nutrition, so far as it is possible to obtain it with the feed available, is an ideal to aim at as the season advances. As the weather becomes colder, more feed is required.

A suitable and very effective worm-drench recommended by the Department for the treatment of parasites in hoggets is prepared as follows: Dissolve 1 lb. of bluestone in 5 gallons of water, and add 16 fluid ounces of a solution of nicotine sulphate. Give the hoggets ½ fluid ounce of the mixture at regular periods of three weeks, or as considered necessary. It is not necessary to fast the hoggets before dosing, but it is advisable to keep the stock away from water for two hours after dosing. The above solution is more concentrated than that previously recommended, but the dosage per head has been reduced proportionately.

The necessity for an adequate and nutritious diet in the successful wintering of hoggets has been emphasized above. Good feeding is the sheet-anchor of successful results and too much stress cannot be attached to it. Whether the farmer has been using the worm-medicine mentioned above, worm-tablets, or other preparations on the market, the necessity for adequate feeding of hoggets still remains. Much of the success achieved by the stud-breeder can be attributed to his close shepherding and his due recognition of the advantage to be gained by the use of supplementary feeding such as chopped roots, chaff, and other foodstuffs.

Chaff is frequently used in the South Island where the winter grass is scarce and there is undoubtedly scope for the greater use of chaff, and good lucerne or clover hay in the wintering of hoggets in parts of the North Island. The difficulty experienced in getting the young stock to eat dry feed while green feed is available can be overcome by the stud-stock breeders and should not prove impossible in the management of ordinary flocks.

The advantage of using some dry feed in a season like the present one lies in increasing the fibre content of the soft feed, in providing variety in the diet, in assisting to prevent scours, and, above all, in providing a supplement in cases where grass is in short supply, a supplement which can be guaranteed to be free from the eggs and larvæ of the several kinds of parasitic worms which undermine the health of our hogget-flocks. The successful wintering of hoggets is in many cases a specialized branch of sheep-husbandry requiring close shepherding and observation and a close study of feeding and attention to detail in management.

RESULTS FROM PASTURE TOP-DRESSING IN CANTERBURY.

R. McGILLIVRAY, Fields Superintendent, Christchurch.

THE successful manuring of pastures in Canterbury, owing to dry climatic conditions, presents more difficulties than is the case where the annual rainfall is greater, but the experience of the farmers mentioned in this article indicates very clearly that autumn top-dressing pays, and this is confirmed by pasture top-dressing trials conducted by the Fields Division of the Department of Agriculture in the dry districts in various parts of Canterbury and Marlborough.

In most cases there has been a distinct response to lime applications, and in the case of applications of lime plus superphosphate wonderfully improved pastures have resulted where applications have been made in the early autumn and in sufficient quantities. An application of 1 ton carbonate of lime plus a minimum dressing of 2 cwt. superphosphate per acre seldom fails to give excellent results.

The failures that one hears of at times can be attributed largely in the first place to inadequate applications of both lime and fertilizers, and secondly to spring applications to dry pastures in dry districts. This is a practice inviting failure, and top-dressing in this way for quick results is largely a waste of effort and of outlay. The meagre applications of lime and phosphates, as practised by some farmers in their top-dressing, have been described aptly as "sending a small boy on a man's errand." A foundation must be laid, and when this has been done lighter annual dressings may then give results.

In addition to the cases mentioned in this article there are many other farmers who are top-dressing successfully in Canterbury, and whose conditions are in no way more favourable than their neighbours; yet success attends the top-dressing of one group and failure of the other group. Success is generally closely allied with early and adequate applications of lime and phosphate applied to good types of vigorous and persistent pasture constitutents.

Mr. Eric C. Gardiner, of "Vulcan Downs," Motunau, North Canterbury, has a holding of 2,472 acres, comprising flats, downland, and fairly steep hills. Mr. Gardiner commenced top-dressing with superphosphate seven years ago. Prior to that time he wintered approximately 2,000 ewes and some cattle. He formerly did considerable cultivation for the purpose of maintaining his stock, and this work cost him, on an average, £800 per annum. Since commencing top-dressing he has disposed of his team and now uses a caterpillar tractor when top-dressing. He annually top-dresses 800 acres and the cost of this work is about £400. The work is carried out in the autumn and as early as February at times. Fairly steep hillsides and manuka-covered faces have been treated, and the present condition of the pastures on these areas rapidly dispels any doubt with regard to the efficacy of top-dressing on this estate. Some parts of the tussock-land have been top-dressed without any seed being sown, and now carry an excellent sward of mixed grasses and white clover. On the manuka areas the scrub was cut and burnt and grass-seed sown. These areas are top-dressed annually, with the result that there is now excellent pasture on land that a few years ago was quite useless.

Last year the total sheep wintered amounted to 3,535, of which 2,560 were ewes, and in addition there were 90 head of cattle, and these, seen in November, proved to be in prime conditon. The lambing percentage ranges from 100 per cent. to 110 per cent. This percentage represents an increase of 10 per cent. compared with the lambing obtained prior to top-dressing. All sheep troubles have been reduced to a minimum and the fleece-weight has increased by 1½ lb. per sheep. Prior to top-dressing, the lambs were practically all sold as stores. Generally not more than two trucks went away fat. Conditions have completely changed under top-dressing, and now there are only a few trucks of lambs not sent away fat off their mothers. Mr. Gardiner has had 1,669 lambs in the works by the 23rd of January, with a weight of about 34 lb. Last season his first draft of nearly 1,000 averaged just under 35 lb. and all were away to the works by the end of January. This, in a year of extreme drought, speaks well for top-dressing and, as Mr. Gardiner explains, top-dressing has transformed his estate from a purely store-stock undertaking into a fat-stock one. Lime is now being used, and it is quite evident from the condition of the pastures where it has been applied that it is going to still further enhance the value of the grazing on this property.

Mr. C. E. T. Elmers, dairy-farmer, Ellesmere, has been top-dressing for the past six years. As a result of the first year's top-dressing there was an increase of 420 lb. of butterfat from the herd. Some top-dressing was done in the second year, but in the third year, owing to the low price of butterfat, top-dressing was not undertaken, with the result that there was a heavy fall in butterfat-production. The owner then realized that it did not pay to cease top-dressing, and in the fourth season applied 1½ cwt. super per acre to 60 acres, and production went up by 61 lb. of butterfat per cow. Mr. Elmers during the fifth and sixth season has increased the quantity of superphosphate used and is also now using considerable quantities of carbonate of lime, with most gratifying results. On this farm one field of 12 acres was top-dressed after a hay crop was secured and closed up for the production of red-clover seed. The clover made most vigorous growth and threshed 34 sacks of seed (approximately 6,800 lb.), or nearly 3 sacks to the acre. This result could not have been achieved except with the aid of an application of top-dressing material, and the owner is of opinion that in his general management it will pay to spend at least £1 per acre per annum on lime and fertilizers.

Mr. James Reid, of Riversleigh, Darfield, has a farm of 428 acres. He has been top-dressing some of his fields annually for eleven years, and these have shown a consistent improvement both in pasture covering and general production. Approximately 180 acres of pastures are top-dressed annually with superphosphate at the rate of approximately 1½ cwt. per acre, and it can be said that in addition to this all crops grown are also manured. There are on the farm 120 acres in wheat and oats and about 300 acres in pasture, roots, and green feed, on which 900 stud English Leicester, Corriedale, and Ryeland sheep are wintered. Mr. Reid is a firm believer in early autumn top-dressing, as he finds that the grass grows much longer into the winter and comes away much earlier in the spring, thus the low-production period is greatly shortened. The top-dressed pastures also stand up much better to dry weather and are far more permanent than are those not treated.

Mr. Reid states that since commencing to fertilize his crops, including his pastures, he has at least doubled the carrying-capacity of the farm. He also points out that the increased pasture carrying-capacity is not the only benefit, as the grain crops following a pasture that has been top-dressed show a very material increase in yield. Mr. Reid has not limed to any extent, and considers superphosphate to be the ideal fertilizer for his relatively dry conditions.

Mr. W. J. Inch, Te Pirita, has a farm of 1,100 acres varying in quality from light stony-plains land to some good river silt. This farm is situated on the north bank of the Rakaia River about fourteen miles inland from Bankside. The owner has been liming and using fertilizers for about six or seven years, and success was attained in the first top-dressing season, although it took two or three seasons to obtain maximum results. The usual time for applying fertilizers is the March–May period, but every endeavour is made to get the work done as early as possible so as to take advantage of the late-autumn and early-winter rains, as the annual rainfall of the locality is relatively quite low. Prior to top-dressing, the carrying-capacity of the farm was 1,100 sheep, of which 850 were ewes. The carrying-capacity is now approximately 1,800 half-breds, of which about 1,150 are ewes. The amount of wool clipped has shown an increase of at least 1 lb. per sheep since top-dressing commenced, and the lambing percentage shows a great improvement, and last year was 118 per cent. In estimating this percentage all dry ewes were included in the count. Since top-dressing commenced the pastures last much longer and large quantities of hay are made where none could be saved before. It has also been noticed that the pasture-plants present on the top-dressed areas withstand dry weather remarkably well and show a rapid growth when rain is experienced. The saving of white-clover seed has also become possible and is at times a highly profitable undertaking. Mr. Inch used superphosphate at the rate of 2 cwt. per acre and lime at about 10 cwt. per acre.

The experiences of the above-named farmers were taken as typical of what is now happening in many districts, and many other similar cases could be recorded. In almost all cases there is very definite evidence that early autumn is the most favourable time in this district in which to apply fertilizers to established pastures. The value of applications of lime are often very distinct, and this is especially so when in combination with superphosphate.

At Otakeho, Taranaki, thirty sows and thirty store pigs grazed for five months on four acres of oats sown in the autumn. The pigs had access to water and, apart from being fed for two weeks on boiled meat, had no other feed. The results were reported upon as quite good.

Several varieties of swede and turnip which are highly resistant to club-root have been introduced, and have been put under thorough trial in competition with standard varieties, chiefly in Southland. After several years of trial the Bruce turnip and the Wilhelmsburger Otofte swede have proved highly resistant. It is not too much to say that the use of such varieties as these on badly infected land means the difference between a reasonable crop and an utter failure in many cases.—*Director of Fields Division, Annual Report.*

CERTIFICATION OF SEED POTATOES.

PROVISIONAL CERTIFICATES ISSUED FOR SEASON 1935-36.

PROVISIONAL certificates are issued with the object of affording growers some indication of the general standard of their crops and assisting them in the disposal of their seed. Certification tags to be attached to the sacks are issued later, provided that an officer of the Department of Agriculture inspects the graded seed potatoes and is satisfied that they are still of the same standard of purity and freedom from disease as was indicated by the field inspection.

Each crop has received a group-number, which indicates as accurately as possible the merits of its produce for seed purposes in relation to the merits of the produce of the other provisionally certified crops of the same variety. Group 1 is the highest and Group 8 the lowest. The difference between any two consecutive groups is small, and in making comparisons the cost of seed and transport should receive consideration.

Crops are also divided into two classes—namely, (1) Certified "Mother" seed; (2) certified "Commercial" seed. Areas sown with certified mother seed are eligible for entry into certification. Areas sown with certified commercial seed are not eligible for entry into certification, except in cases where the seed planted has been raised by the entrant (grower) himself. Growers who intend to purchase seed with the object of entering certification must therefore purchase certified mother seed.

LIST OF GROWERS.

Name and Address.	Group No.	Area in Acres.
AUCKLANDER SHORT TOP.		
Mother Seed (Canterbury and Marlborough)—		
Adams Bros., Sheffield (Line A)	2	6
Adams, K. and R., Sheffield (Line A)	3	1
Adams, K. and R., Sheffield (Line B)	3	5
Amor, A. W., Woodend (Line A)	3	1
Amor, A. W., Woodend (Line B)	3	2
Amor, A. W., Woodend (Line C)	2	2
Amyes, H. C., "Riversleigh," Annat	3	2
Anderson, A., Southbridge (Line A)	2	1
Anderson, A., Southbridge (Line B)	3	3
Anderson H. (Estate of), Springston, R.M.D. (Line C)	3	1½
Armstrong, P. L., Fernside, R.D., Rangiora	3	5
Ballantyne's Estate, Fairview, Timaru (Line A)	3	3
Barclay, G. M., Riverlands, Waimate	2	1
Barnett, R., Dunsandel (Line A)	3	5
Barnett, R., Dunsandel (Line B)	3	1
Barr, H. C., Springston, R.D.	3	2
Boyce, W. J., Waituna, Waimate	3	1½
Boyle, A. D., Orari	3	2
Breakwell, A. J., Tinwald (Line A)	3	2
Breakwell, A. J., Tinwald (Line B)	2	2
Brown, G. E., Kaiapoi, R.M.D. (Line A)	2	5
Brown, G. E., Kaiapoi, R.M.D. (Line B)	2	3
Brown, J. L., Washdyke	3	1
Burrell, T. F., Levels	2	1½
Cague, W., St. Andrews	3	1½
Caldwell, G., Courtenay, R.M.D.	2	3
Campion, C. A., Mount Hutt, R.D., Rakaia	3	1
Carroll, F. A., Southbridge	3	2
Carroll, J., Southbridge	1	4
Carroll, T. F., Southbridge	2	4
Chambers, A. J., Carberry, Weedons	3	2
Chambers, W. J., Weedons, Greendale, R.D.	3	2
Chappell, T., West Coast Road, Yaldhurst (Line A)	2	1
Chatterton, C. S., Dunsandel	2	1

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Area in Acres.
AUCKLANDER SHORT TOP—*continued.*		
Mother Seed (Canterbury and Marlborough)—continued.		
Cook, P. D., Albury, South Canterbury (Line B) ..	3	1
Couper, R. P., Meadows, Washdyke (Line A)	3	1
Cox, N., 238 Wairarapa Road, Christchurch, N.W. 3 (Line A)	3	2
Cross, A. E., Bennett's, via Rangiora (Line A)	3	1
Cross, A. E., Bennett's, via Rangiora (Line B)	3	2
Cross, H. E., Sandy Knolls	3	1
Crozier, W. J., Mount Hutt, R.D., Rakaia (Line A) ..	2	1½
Crozier, W. J., Mount Hutt, R.D., Rakaia (Line B) ..	3	3
Crump, F., Springston, R.D.	3	3
Dale Bros., Maungati, South Canterbury	3	2
Doyle, P. J., Gleniti, Timaru	3	1½
Ellis, M. G., Kingsdown, Timaru	3	1
Ferguson, J. W., Winchmore, R.M.D.	3	4
Foster, J. A., Springston, R.M.D.	3	10
Foster, T. C., Springston, R.M.D.	2	9
Franks, L. J., 88 Russley Road, Christchurch, N.W. 3 (Line A)	2	2
Franks, L. J., 88 Russley Road, Christchurch, N.W. 3 (Line B)	3	2
Gardiner, O. J., Dunsandel, R.M.D.	1	1
Gaskell, L., 112 Russley Road, Christchurch, N.W. 3 ..	1	1
Gilbert, D. R., East Oxford	3	1
Gray, J. L., St. Andrews (Line A)	3	3
Gray, P. B., Hadlow, Tycho, R.D.	3	1
Gray, R., St. Andrews (Line A)	3	2
Guy, T. A. and E. B., Courtenay, R.D.	3	6
Hartnett, T., Rangatira Valley, Temuka	3	1½
Hastie, A. W., Pareora, Timaru (Line A)	3	1½
Hastie, A. W., Pareora, Timaru (Line B)	3	1
Heinisch, A., Springston, R.D.	3	1
Henderson, G. H., Courtenay, R.D.	3	2
Hewson, R. H., Seadown, Timaru	3	2
Hill, J., Pareora West	3	1
Hobday, J. H., 33 St. John Street, Christchurch, N.W. 2 (Line A)	3	3
Hobday, J. H., 33 St. John Street, Christchurch, N.W. 2 (Line B)	3	2
Jackman, J., 24 Eversleigh Street, Christchurch, N. 1 ..	3	2
Jellie, J., Russley Road, Christchurch	2	3
Johnston, R. H., Dunsandel	3	2
Kavanagh, Mrs. M., 50 Ryan's Road, Upper Riccarton ..	3	10
Kelleher, T., Pleasant Point (Line A)	3	2
Kennedy, L. J., Postman's Road, Kaikoura	3	1
Kenyon, F., Oxford Road, Rangiora	3	3
King and Co., care of G. H. King, West Belt, Rangiora (Line A)	3	3
King and Co., care of G. H. King, West Belt, Rangiora (Line C)	2	1
King, G. H., West Belt, Rangiora (Line A)	3	4
King, G. H., West Belt, Rangiora (Line B)	3	1
King, J. C., Landsboro, Timaru	3	1
King, W. H., Rosewill, R.D., Timaru (Line A)	3	2
King, W. H., Rosewill, R.D., Timaru (Line B)	3	2
Lynch, R., Fairview, Timaru	3	1½
McCaw, W. T., Tycho	3	3
McCullough, S. G., Temuka (Line A)	3	1
McPhail, W., Mitcham, via Rakaia	1	2
Mackle Bros., Kaikoura, Suburban	3	1

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Area in Acres.
AUCKLANDER SHORT TOP—*continued.*		
Mother Seed (Canterbury and Marlborough)—continued.		
Marshall, D., Leeston, R.M.D.	3	10
Marshall, S. A., Tycho, R.D., Timaru	3	3
Martin, W. E., Kaiapoi, R.M.D. (Line A)	3	1
Martin, W. E., Kaiapoi, R.M.D. (Line B)	3	11
Moore, H. S., Box 4, Kaiapoi (Line A)	2	3
Moore, H. S., Box 4, Kaiapoi (Line B)	2	2
Morgan, D., Cheviot, R.D.	1	13
Morrison, J. L., Morven	3	2
Mortland, Mrs. S., Templeton	3	6
Mulcock, W. J., 34 Ryan's Road, Christchurch, N.W. 3	3	2
Nicklaus, J. F., 104 Ryan's Road, Christchurch, N.W. 3	2	5
Oakley, H. R., Eiffelton, R.D.	3	3
Oakley, W., Hororata (Line A)	2	4
Oakley, W., Hororata (Line B)	3	13
Oliver, J. O. J., Factory Road, Temuka (Line A)	3	2
Oliver, Mrs. Z. M., Factory Road, Temuka (Line A)	3	1
Parker, F. A., Spring Creek, Blenheim (Line B)	3	1
Pascoe, S., Halkett (Line B)	3	2
Penn, T. A., 39 Weston Road, Christchurch, N. 1 (Line A)	3	3
Penn, T. A., 39 Weston Road, Christchurch, N. 1 (Line B)	3	3
Petrie, H. H., Swannanoa, R.D.	3	8
Petrie, J., sen., Swannanoa, R.D.	3	4
Phillips, W., Springston, R.D.	3	1
Porter and Rouse, St. Andrews (Line A)	3	3
Prosser, L. W., Leeston	3	3
Purvis, G., Oxford Road, Rangiora	3	4
Randall, J., Koromiko, Marlborough	3	1
Rangiora High School, Rangiora	3	4
Rathgen, A. E., Leeston, R.D.	3	5
Redmond, C., Kimberley, R.D.	2	15
Rich, A. J., Kaiapoi, R.D.	3	12
Richmond, W. T., Willowbridge (Line A)	3	1
Robinson, R. G., Ltd., Box 4, Papanui	3	4
Rollinson and Sons, Studholme Junction	3	3
Rolston, G., Whincops Road, Halswell	2	4
Roper, P. F., Halkett	2	6
Roper, R. S., Halkett	3	2
Rose, C. F., Hook, South Canterbury	3	2
Ross, A., Washdyke (Line A)	3	1
Ross, A., Washdyke (Line B)	3	2
Royds, R. S., 12 Burnside Road, Christchurch, N.W. 1	3	5
Ruddenklau, J. G., The Valley, Glenavy (Line A)	3	33
Scott, A., Kerrytown, South Canterbury	2	1
Shillito, R. S., 135 Armagh Street, Christchurch, C. 1	3	3
Sievwright, R. M., Meadows, Washdyke	3	4
Simpson, F. F., Morven (Line A)	3	6
Simpson, F. F., Morven (Line B)	3	6
Simpson, F. F., Morven (Line C)	3	3
Smith, E. A., Springston, R.D. (Line A)	3	15
Smith, R. S., St. Andrews (Line A)	3	1½
Smith, R. S., St. Andrews (Line B)	3	1
Steele and Dawson, care of F. Steele, Fernside, Rangiora	2	2
Steele, J., Kimberley	2	3
Stewart, A., Marsh's Road, Templeton (Line A)	3	7
Stewart, A., Marsh's Road, Templeton (Line B)	3	1
Swanson, W., Selwyn	2	2
Tallott, E. D., Cust	2	4
Thomas, J. W., Gray's Road, Christchurch, N.W. 3	3	4

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Area in Acres.
AUCKLANDER SHORT TOP—*continued.*		
Mother Seed (Canterbury and Marlborough)—continued.		
Topham, J. W., Arowhenua, Temuka (Line B)	3	1
Tweedy, S., Dunsandel, R.D.	3	4
Upston, E. E., Selwyn	3	2
Walker, C. F. (Estate of), Christchurch, Greendale, R.D.	3	5
Watson, R. G., Cust (Line A)	3	3
Watson, R. G., Cust (Line B)	3	3
Westaway, R. J., Christchurch, Greendale, R.D.	3	14
Whearty Bros., Wheatstone, Ashburton	2	1
Wilson Bros., Halkett, R.D. (Line A)	2	5
Wilson, C. T., Halkett, R.D. (Line A)	3	2
Wilson, C. T., Halkett, R.D. (Line B)	2	3
Wilson, M. G., Springston, R.D.	2	2
Wilson, W. A., Halkett, R.D. (Line B)	3	2
Wilson, W. A., Halkett, R.D. (Line C)	3	2
Wolff, R. G., Horrelville, R.D.	1	3
Wright, L. T., Annat	2	10
Wright, Q. A., Annat	3	8
Mother Seed (Otago and Southland)—		
Miles, A. C. and E., Portobello	3	2
Miller, R., East Taieri (Line A)	3	4
Commercial Seed (Canterbury and Marlborough)—		
Adams Bros., Sheffield (Line B)	4	4
Alexandre, H., Belfast (Line A)	4	1
Alexandre, H., Belfast (Line B)	4	2
Alexandre, H., Belfast (Line C)	5	5
Anderson, H. (Estate of), Springston, R.D. (Line A)	4	2
Anderson, H. (Estate of), Springston, R.D. (Line B)	4	2
Bailey, J., Kaiapoi, R.D.	5	5
Ballantyne's Estate, Fairview, Timaru (Line B)	4	5
Barnes, W., and Sons, 199 Highsted Road, Styx, N.W. 4	4	2
Bennett, R. R., Eyreton, R.D. (Line A)	4	1
Bennett, R. R., Eyreton, R.D. (Line B)	4	3
Berry and Halliburton, 28 Dundas Street, Christchurch, C. 1	4	4
Breen, M., Levels (Line A)	4	3
Breen, M., Levels (Line B)	4	1
Campbell, H., Clandeboye	4	1
Carr, J., Mount Hutt, R.D., Rakaia	4	2
Caskey, R., Gleniti, Timaru	4	1
Chapman, N. J., Kaiapoi	5	1
Chappell, T., West Coast Road, Yaldhurst (Line B)	5	1
Cherry Bros., Eyreton-Kaiapoi, R.D. (Line A)	4	1½
Cherry Bros., Eyreton-Kaiapoi, R.D. (Line B)	4	2
Cook, P. D., Albury, South Canterbury (Line A)	5	4
Couper, R. P., Washdyke (Line B)	4	1
Cox, N., 238 Wairarapa Road, Christchurch, N.W. 3 (Line B)	5	1½
Dale, W. S., Kennerley, Temuka	5	2
Dillon, J. G., Courtenay, R.D.	4	4
Dyer, H., Southbrook	6	1½
Eder, T. W., Woodend	6	2
Eder, W., Sefton, R.D. (Line B)	5	4
Elder, R. P., 109 Johns Road, Belfast	4	1
Elworthy, P. A., Gordon's Valley, South Canterbury	5	2
Farr, L. E., Bennets	4	4
Frost, C. H., Balcairn Post-office	5	1
Gaffeney, Mrs. M. F., Arowhenua, Temuka	4	3

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Area in Acres.
AUCKLANDER SHORT TOP—*continued.*		
Commercial Seed (Canterbury and Marlborough)—continued.		
Gray, J. L., St. Andrews (Line B)	4	9
Gray, R., St. Andrews (Line B)	4	8
Haines, C., 108 Waimak Road, Christchurch, N.W. 4	5	2
Ham, A., Grove Town, Blenheim	4	3
Hayman, T. L. and A. F., Studholme Junction	5	1½
Heer, A. F., Clandeboye	4	1
Hegan, J., and Son, Southbrook (Line A)	6	3
Hegan, J., and Son, Southbrook (Line B)	6	6
Hewson, Mrs. M. S., Orari	4	1
Jordan, C. H., Kaiapoi, R.D.	4	2
Jowers, G. C., Springston, R.D.	4	1½
Kelleher, T., Pleasant Point (Line B)	6	6
Kelleher, T., Pleasant Point (Line C)	4	4
King and Co., care of G. H. King, West Belt, Rangiora (Line B)	4	2
McCarthy, E., Prebbleton	4	2
McCullough, S. G., Temuka (Line B)	4	3
McDermott, E. C., 25 Tankerville Street, Christchurch, S.W. 2 (Line A)	5	5
McDermott, E. C., 25 Tankerville Street, Christchurch, S.W. 2 (Line B)	4	2
McGrath, J., Sefton	6	1½
Marshall, W. H., Prebbleton	4	2
Matson, H., and Co., Box 3, Christchurch, C. 1	4	5
Millar, J. E., Killinchy, via Leeston	5	1½
Mills, F. F., Grovetown, Blenheim	4	1
Oliver, J. O. J., Factory Road, Temuka (Line B)	5	2
Oliver, Mrs. Z. M., Factory Road, Temuka (Line B)	5	1
Oliver W. R., Hororata	4	2
O'Loughlin, J. (Estate of), St. Andrews	4	1
Parker, F. A., Spring Creek, Blenheim (Line A)	4	1
Pascoe, S., Halkett (Line A)	6	3
Patterson, A., East Eyreton - Kaiapoi, R.D.	6	5
Payton, J. E., Middle Lincoln Road, Halswell	4	3
Porter and Rouse, St. Andrews (Line B)	4	15
Prebble, R. L., Springston, R.D.	5	8
Proudlock, A., East Eyreton - Kaiapoi, R.D.	6	6
Redmond, W. G., Courtenay, R.D.	4	6
Reynolds, H., Sawyers' Arms Road, Harewood, N.W. 4	4	1
Richmond, W. T., Willowbridge (Line B)	4	1
Robinson, R. P., Waikuku	4	2
Ross, W., Waimate	4	1
Ruddenklau, J. G., The Valley, Glenavy (Line B)	4	13
Saunders, A., Yaldhurst	5	1
Saunders, E. E., Studholme	4	2
Schluter Bros., Rangiora	4	7
Seaton Bros., Courtenay, R.D.	4	4
Seyb, L., Washdyke	6	1
Sharlick, J., Marshlands Road, Ouruhia (Line A)	5	5
Sharlick, J., Marshlands Road, Ouruhia (Line B)	5	5
Shellock, W., Te Pirita, R.D., Rakaia	5	1
Spillane, A., Temuka (Line A)	4	1
Spillane, A., Temuka (Line B)	5	1
Storer, G., Halswell	4	6
Tiffen Bros., Makikihi	5	2
Topham, J. W., Arowhenua, Temuka (Line A)	4	1
Traves, H., Levels	6	1½
Walker, W. H., jun., Halkett, R.M.D.	4	1½

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Area in Acres.
AUCKLANDER SHORT TOP—*continued.*		
Commercial Seed (Canterbury and Marlborough)—continued.		
Ward, C. R. T., Ladbrooks (Line A)	6	1½
Ward, C. R. T., Ladbrooks (Line B)	6	1½
Weeber, H., Englefield Road, Belfast, N. 2 (Line A)	5	2
Weeber, H., Englefield Road, Belfast, N. 2 (Line B)	4	9
Weeber, H., Englefield Road, Belfast, N. 2 (Line D)	4	1
Williams, C. M., Box 19, Kaiapoi	4	5
Wilson Bros., Halkett, R.D. (Line B)	4	5
Commercial Seed (Otago and Southland)—		
Miller, R., East Taieri (Line B)	6	2
DAKOTA.		
Mother Seed (Canterbury and Marlborough)—		
Adams, A., Killinchy, via Leeston	4	1½
Allen, A., Killinchy, via Leeston (Line A)	4	16
Allen, A., Killinchy, via Leeston (Line B)	5	8
Ashwell, L., Christchurch-Greendale, R.D.	4	1
Barnes, C. F., Cheviot, R.D.	4	2
Barnett, R., Dunsandel	5	4
Beer, G. F., Horrelville, R.D.	4	4
Bennett, W., North Loburn	4	2
Brown, G. E., Kaiapoi, R.D.	4	1
Boyle, W., Springston, R.D.	4	1
Brodie, R., Rangitata Island	5	2
Campbell, D. A., King Street, Rangiora (Line A)	4	2
Campion, C. A., Mount Hutt, R.D., Rakaia	4	4
Carr, J., Mount Hutt, R.D., Rakaia	5	6
Chambers, L. J., "Carberry," Weedons, R.D.	5	6
Chambers, R., Rolleston	5	5
Chapman, N. J., Kaiapoi	5	4
Chatterton, W. V., Dunsandel (Line A)	4	1
Cross, A. E., Bennetts, via Rangiora	5	1
Cross, H. E., Sandy Knolls	5	6
Crozier, W. J., Mount Hutt, R.D., Rakaia (Line A)	4	1½
Farmer, F., Springston, R.D.	5	2
Fine, F., and Stead, E. F., care of G. Fine, 57 Springs Road, Sockburn, W. 2	4	4
Foster, T. C., Springston, R.D.	4	7
Fowler, G. H., Halkett, R.D.	4	3
Gardiner, O. J., Dunsandel, R.D.	2	5
Giles, N., Seadown, Timaru	4	3
Goodman, L., Levels	5	1
Hennessey, W., Mitcham, via Rakaia (Line A)	5	1
Hennessey, W., Mitcham, via Rakaia (Line B)	5	1
Hewson, R. H., Seadown, Timaru	4	3
Hill, L. F., Eiffelton, R.D.	4	5
Hooper, R. M., Mitcham, via Rakaia	5	3
Hoskin, S., Doyleston	5	2
Johnston, H. W., Box 12, Dunsandel	2	10
Johnston, R. H., Dunsandel	4	2
Jowers, G. C., Springston, R. D.	5	3
King and Co., care of G. H. King, West Belt, Rangiora	5	19
McCarthy, E., Prebbleton	5	5
McNickol, care of H. S. Stevens, Mount Hutt, R.D., Rakaia	4	2
McPhail, W., Mitcham, via Rakaia	3	14
McRobb, A., Mount Hutt, R.D., Rakaia (Line A)	4	5
McRobb, A., Mount Hutt, R.D., Rakaia (Line B)	5	4
Marshall, D., Leeston, R.D.	4	15

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Area in Acres.
DAKOTA—*continued.*		
Mother Seed (Canterbury and Marlborough)—continued.		
Marshall, W. H., Prebbleton (Line A)	5	2
Marshall, W. H., Prebbleton (Line B)	5	2
Minchington, F. W., Fernside, Rangiora	4	1½
Moore, H. S., Box 4, Kaiapoi	5	5
Orbell, W. H., Levels	5	1
Payne, J., Yaldhurst-Courtenay, R.D. (Line B)	5	3
Payne, S., Lincoln	5	3
Petrie, J., sen., Swannanoa	5	5
Prosser, Mrs. M. A., Leeston	5	4
Royds, R. S., 12 Burnside Road, Christchurch, N.W. 1	5	6
Ruddenklau, J. G., The Valley, Glenavy (Line A)	5	8
Ruddenklau, J. G., The Valley, Glenavy (Line B)	5	8
Ruddenklau, J. G., The Valley, Glenavy (Line D)	4	14
Ruddenklau, J. G., The Valley, Glenavy (Line E)	5	6
Ryan, P. F., Weedons-Springs, R.D. (Line A)	5	8
Ryan, P. F., Weedons-Springs, R.D. (Line B)	5	8
Saunders, A., Yaldhurst	5	1
Shellock Bros., Te Pirita, R.D., Rakaia	3	6
Shellock, W., Te Pirita, R.D., Rakaia	3	5
Steele, J., Kimberley	5	1
Stewart, A., Marsh's Road, Templeton (Line A)	5	7
Stewart, A., Marsh's Road, Templeton (Line B)	5	4
Swanson, W., Selwyn	4	3
Thomas, C., Springston, R.D. (Line A)	4	2
Topham, J. W., Arowhenua, Temuka (Line B)	5	1
Tweedy, S., Dunsandel, R.D.	3	11
Walker, C. E. (Estate of), West Melton, R.D.	5	5
Warren, J., Russley Road, Fendalton, Christchurch	5	9
Whearty Bros., Wheatstone, Ashburton	3	1
Wilson, M., Halkett, R.D.	3	5
Wolff, R. G., Horrelville, R.D.	5	7
Commercial Seed (Canterbury and Marlborough)—		
Alexandre, H., Belfast	7	4
Amor, A. W., Woodend (Line B)	6	2
Barnett, G. L., Lakeside	7	2
Benny, G., Southbridge	7	3
Berry and Halliburton, 28 Dundas Street, Christchurch, C. 1	6	6
Boyce, A., Doyleston	6	3
Breakwell, A. J., Tinwald (Line A)	7	3
Breakwell, A. J., Tinwald (Line B)	7	4
Breen, J. and W., Levels	7	2
Burrowes, J., Chertsey (Line A)	6	2
Burrowes, J., Chertsey (Line B)	6	2
Campbell, D. A., King Street, Rangiora (Line B)	6	4
Chambers, A. J., " Carberry," Weedons, R.D.	7	4
Chambers, W. J., " Carberry," Weedons, R.D.	6	7
Cherry Bros., Kaiapoi, R.D.	7	2
Crozier, W. J., Mount Hutt, R.D., Rakaia (Line B)	6	5
Dale, W. S., Kennerley, Temuka	7	1½
Demus, H. F., Geraldine	6	1
Ellmers, J. W., Kaiapoi	7	5
Gardiner, C., care of W. Wilson, Kirwee	7	4
Gerard, C., 40 Plynlimmon Street, Christchurch, N.W. 1	6	1
Gibbs, G., Sawyers Arms Road, Harewood, N.W. 4	7	3
Gill, R. W., Springlands, Blenheim	7	2
Gillman, R. E., Woodend	6	4
Guy, W. V., Rangiora-Springbank, R.D.	7	5

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Area in Acres.
DAKOTA—*continued.*		
Commercial Seed (Canterbury and Marlborough)—continued.		
Lambie, R. T., Leeston	7	6
McCartin, J., Leeston	6	8
McKenzie, J., 3 Asylum Road, Christchurch, S.W. 2	6	1½
McLachlan, T. C., Leeston, R.D.	6	10
McCullough, S. G., Rangatira Valley, Temuka	6	3
Mehrtens, J. L., Camside, Rangiora	6	3
Moorhead Bros., Southbridge (Line A)	7	4
Moorhead Bros., Southbridge (Line B)	6	22
Nicklaus, J. F., 104 Ryan's Road, Christchurch, N.W. 3	7	1
Norman, F. J., Springlands, Blenheim (Line A)	7	2
Oakley, W., Hororata	6	3
Pannell, W. B., Rangiora, R.D.	7	6
Parker, F. A., Spring Creek, Blenheim (Line A)	6	4
Parker, F. A., Spring Creek, Blenheim (Line B)	6	4
Payne, J., Yaldhurst-Courtenay, R.D. (Line A)	7	5
Payne, J. L., Lincoln	7	3
Peach, J., Sefton, R.D.	7	2
Petrie, H. H., Swannanoa, R.D.	6	2
Phillips, A., Weedons-Springston, R.D.	6	10
Phillips, A. G., Weedons-Springston, R.D. (Line A)	6	5
Phillips, A. G., Weedons-Springston, R.D. (Line B)	6	1
Phillips, W., Springston, R.D.	6	5
Purvis, R. M., Oxford Road, Rangiora	6	3
Redmond, W. G., Courtenay, R.D.	6	4
Reid, G., Woodend Post-office	7	2
Robinson, R. P., Waikuku	7	5
Robson, F. H., Box 22, Lincoln	7	4
Ruddenklau, J. G., The Valley, Glenavy (Line C)	6	20
Schaffer, F. L., Springston, R.D.	6	20
Schluter Bros., Rangiora	6	3
Thomas, C., Springston, R.D. (Line B)	6	5
Topham, J. W., Arowhenua, Temuka (Line A)	6	2
Tully, B., Woodend	7	3
Ward, C. R. T., Ladbrooks	6	4
Watson, M. E. M., Dunsandel	6	7
Weeber, H., Englefield Road, Belfast, N. 2	7	1½
White, R. Y., 402 North Road, Styx, N. 2	6	1
Williams, J. W., Whincops Road, Halswell, S.W. 2	7	5
Wilson, M. G., Springston, R.D.	7	3
Winter, E. R. V., Brookside (Line A)	7	2
Winter, E. R. V., Brookside (Line B)	7	1
Wright, Q. A., Annat	7	8
ARRAN CHIEF.		
Mother Seed (Canterbury)—		
Barclay, G. M., Riverlands Road, Waimate	4	6
Batchelor, R. S., Waimate	3	1
Boyce, W. J., Waituna, Waimate	4	2
Campbell, P., Studholme Junction	3	4
Connell, M., Arowhenua, Temuka	3	3
Cox, S., Box 9, Willowbridge (Line A)	3	3
Croft, R., "Glenlea," Amberley	4	2
Hayman, T. L. and A. F., Studholme Junction (Line A)	4	2
Henshaw, J. F., Studholme Junction (Line A)	3	2
Lindsay, J., Studholme Junction (Line A)	3	1
Morris, M. J., Willowbridge	3	2
Rollinson and Sons, Studholme Junction (Line A)	3	6
Rollinson and Sons, Studholme Junction (Line B)	3	11

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Area in Acres.
ARRAN CHIEF—*continued.*		
Mother Seed (Canterbury)—continued.		
Ruddenklau, J. G., The Valley, Glenavy (Line A) ..	3	6
Ruddenklau, J. G., The Valley, Glenavy (Line C) ..	3	2
Ruddenklau, J. G., The Valley, Glenavy (Line D) ..	4	46
Saunders, E. E., Studholme Junction (Line A)	3	2
Wilson, E. R., Junction Road, Waimate (Line A) ..	3	3
Wright, L. T., Annat	2	5
Mother Seed (Otago and Southland)—		
Bruce, J. A., Otahuti, R.D., Invercargill (Line A) ..	4	3
Daly, P. G., Te Wae Wae	4	2
Dobbie, R., Menzies Ferry	3	1½
Forde Bros., Te Tua Post-office	3	1
Griffin, J. G., Te Wae Wae	3	3
Hamilton, G., Tuatapere, R.D.	4	2
Knowler, C. E., Box 97, Tuatapere	4	4
Knowler, H., sen., Te Waewae	2	4
Miller, R., East Taieri (Line B)	4	1½
Orbell, A., Waikouaiti	3	1½
Commercial Seed (Canterbury)—		
Barnes, W., and Son, 199 Highstead Road, Styx, N.W. 4 (Line A)	5	2
Cox, S., Box 9, Willowbridge (Line B)	5	3
Fletcher, W. J., "Hopefields," Willowbridge (Line A) ..	5	2
Fletcher, W. J., "Hopefields," Willowbridge (Line B) ..	5	5
Hamilton, A., Lincoln	6	5
Hayman, T. L. and A. F., Studholme Junction (Line A) ..	7	2
Henshaw, J. F., Studholme Junction (Line B)	6	1½
Henshaw, J. F., Studholme Junction (Line C)	5	5
Kelly, D., Willowbridge	5	4
Lange, C., Willowbridge (Line A)	5	1½
Lange, C., Willowbridge (Line B)	5	2
Leathwick, A., Hunter, R.D., Waimate	7	10
Lindsay, J., Studholme Junction (Line B)	5	1½
Mackenzie, J., 3 Asylum Road, Christchurch, S.W. 2 ..	5	3
Moore, H. S., Box 4, Kaiapoi (Line A)	5	2
Moore, H. S., Box 4, Kaiapoi (Line B)	5	8
Ruddenklau, J. G., The Valley, Glenavy (Line B) ..	5	8
Saunders, E. E., Studholme Junction (Line B)	5	7
Saunders, F. L., Studholme Junction (Line A)	6	4
Saunders, F. L., Studholme Junction (Line B)	5	4
Smith, W. J. M., Seadown, Timaru	5	2
Storer, G., Halswell	5	1
Topham, J. W., Arowhenua, Temuka	5	5
Wilson, E. R., Junction Road, Waimate (Line B) ..	5	12
Commercial Seed (Otago and Southland)—		
Anderson, A., Stirling	5	7
Bathgate, A., Outram (Line A)	6	2
Bathgate, P., Outram	5	4
Beckingsale, J. H., Herbert	6	1
Bennett, J., jun., Papatotara, R.D., Tuatapere	5	3
Bruce, J. A., Otahuti, R.D., Invercargill (Line B) ..	5	1½
Buzan, C. E., Totara, North Otago	5	1
Craig, G. H., Mosgiel	6	1
Graham, J. W., Mosgiel	5	1
Graham, Mrs. K. G., Mataura	5	2
Harvey, W., Mosgiel	5	5

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Area in Acres.
ARRAN CHIEF—*continued.*		
Commercial Seed (Otago and Southland)—continued.		
Knowler, H. C., jun., Te Waewae	5	4
Marshall, W., and Son, Outram	5	2
Miller, R., East Taieri (Line A)	5	1
O'Neill, J. J., Kai Ora, R.D., Oamaru	5	1
Sheddan, G. B., Otahuti R.D., Invercargill	6	1
Skinner, J. L., North Taieri	5	1
Weir, J. G., Stirling (Line A)	5	8
Weir, J. G., Stirling (Line B)	6	2
KING EDWARD.		
Mother Seed (Canterbury)—		
Frewn Bros., Waimate	4	1
Penn, T. A., 39 Weston Road, Christchurch, N. 1	4	1½
Ruddenklau, J. G., The Valley, Glenavy	4	5
Saunders, F. L., Studholme Junction	4	1
Sides, J. G., Studholme Junction	4	1
Mother Seed (Otago and Southland)—		
Bennett, J., jun., Tuatapere	2	2
Craig, G. H., Mosgiel (Line A)	4	1
Daly, P. G., Te Waewae	3	1½
Forde Bros., Te Tua Post-office	3	2
Graham, J. W., Mosgiel (Line B)	4	2
Griffin, J. G., Te Waewae	3	2
Hamilton, G., Tuatapere, R.D.	3	4
Heenan, T. D., Maungatua	3	1
Imrie, J. (Estate of), Mosgiel (Line A)	4	2
Knowler, H. C., jun., Te Waewae	2	1
Kokay, S., Tuatapere	3	16
Ledington, F., Lochiel	3	1
Marshall, W., and Sons, Outram	4	2
Milburn, M., Wright's Bush, R.D., Invercargill	2	1½
Miller, R., East Taieri (Line A)	3	2
Ryan, P., and Sons, Gorge Road, Southland	3	2
Scott, A. P., Box 15, Otautau	3	3
Thornton Bros., Momona, Otago	4	3
Thorp, O. R., Te Houka, Balclutha	4	1½
Waite, A., Tapanui	3	1
Wilson, C. H., Lorneville, Invercargill	3	1½
Commercial Seed (Canterbury)—		
Bisdee, J. C., Clandeboye, Temuka	5	1
Guthrie, A., Clandeboye, Temuka	5	1
Commercial Seed (Otago and Southland)—		
Anderson, A., Stirling	6	3
Burgess, D., West Plains, Invercargill	6	2
Craig, G. H., Mosgiel (Line B)	5	1
Graham, J. W., Mosgiel (Line A)	5	2
Hellyer, F., Macandrew Bay, Dunedin	6	1
Imrie, J. (Estate of), Mosgiel (Line B)	5	2
Kenny, J., Mosgiel	5	4
Miller, R., East Taieri (Line B)	5	1½
Skinner, J. L., North Taieri	5	2
South Taieri Young Farmers' Club, Berwick	5	1
Wilkins, Mrs. E. A., Mosgiel (Line A)	5	2

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Area in Acres.
ARRAN BANNER.		
Mother Seed (Canterbury)—		
Amyes, H. C., "Riversleigh," Annat, R.D.	4	2
Wright, L. T., Annat	3	5
Mother Seed (Otago and Southland)—		
Craig, G. H., Mosgiel	4	1
Daly, P. G., Te Wae Wae	4	1
Graham, J. W., Mosgiel	4	2
Heenan, T. D., Maungatua	3	3
Knowler, C. E., Box 97, Tuatapere	4	1
Knowler, H., sen., Te Wae Wae	4	1½
Kokay, S., Tuatapere	4	2
Commercial Seed (Canterbury)—		
Bird, A. M., Timaru Road, Waimate	5	4
Leathwick, A., Hunter, R.D., Waimate	6	3
Oakley, W., Hororata	6	6
Simmons, W., Kingsdown, Timaru	6	3
White, R. Y., 402 North Road, Christchurch, N. 2	5	1
Commercial Seed (Otago and Southland)—		
Anderson, A., Stirling	5	2
Bruce, J. A., Otahuti, R.D., Invercargill	5	1
Buzan, C. E., Totara, North Otago	6	1
Carr, C., and Sons, Pukemaori, R.D.	5	1
Harvey, W., Mosgiel	5	3
Hellyer, F., Macandrew Bay, Dunedin	5	1½
Leen, C. R., Kakanui, North Otago	5	1½
Miller, R., East Taieri	5	1
Preen, E. C., Box 25, Oamaru	6	1
Sheddan, G. B., Otahuti, R.D., Invercargill	6	1
Smith, C. R. (Estate of), Bushey, Palmerston	5	2
Weir, J. G., Stirling	6	1
AUCKLANDER TALL TOP.		
Mother Seed (Canterbury)—		
Bailey, J., Kaiapoi, R.D.	2	2
Breakwell, A. J., Tinwald	1	2
Cross, H. E., Sandy Knolls	1	3
Ellis, M. G., Kingsdown, Timaru	2	2
Frost, C. H., Balcairn Post-office	2	5
Guy, T. A. and E. B., Courtenay, R.D.	1	4
Horgan, C., Temuka	2	2
Minchington, F. W., Fernside Post-office	2	3
Roper, R. S., Halkett, R.D.	3	2
Seyb, L., Washdyke	3	1
Simmons, W., Kingsdown, Timaru	2	1
Steele and Dawson, care of F. Steele, Fernside (Line A)	3	7
Steele and Dawson, care of F. Steele, Fernside (Line B)	3	3
Commercial Seed (Canterbury)—		
Frost, S. W., Kaiapoi, R.D.	5	4
Gibbs, G., Sawyers Arms Road, Harewood, Christchurch, N.W. 4	4	2
Judson, C. J., High Street, Rangiora	4	9
Marshall, W. H., Prebbleton	5	1
Reynolds, H., Sawyers Arms Road, Harewood, Christchurch, N.W. 4 (Line A)	4	5

LIST OF GROWERS—*continued*.

Name and Address.	Group No.	Area in Acres.
EPICURE.		
Mother Seed (Canterbury)—		
Hobday, J. H., 33 St. John Street, Christchurch, N.W. 2	3	3
Macdonald, R., Annat	3	1
Marshall, D., Leeston, R.D.	3	3
Robinson, R. G., Ltd., Box 4, Papanui (Line A)	5	2
Shillito, R. S., 135 Armagh Street, Christchurch, C. 1	3	3
Wright, L. T., Annat	5	2
Commercial Seed (Canterbury and Marlborough)—		
Parker, F. A., Spring Creek, Blenheim	6	1
Robinson, R. G., Ltd., Box 4, Papanui (Line B)	7	2
Commercial Seed (Otago and Southland)—		
Burgess, D., West Plains, Invercargill	6	1
Kirk, R., Tapanui	6	1
EARLY ROSE.		
Mother Seed (Canterbury)—		
Basher, W. F., Walters Road, Marshlands	4	1
Caldwell, G., Courtenay, R.D.	4	2
Church, G. H., Patten Street, Christchurch, N.E. 1	3	1
Commercial Seed (Canterbury and Marlborough)—		
Parker, F. A., Spring Creek, Blenheim	5	1½
Penn, T. A., 39 Weston Road, Christchurch, N. 1	6	1
Shellock Bros., Te Pirita, R.D., Rakaia	5	5
Shellock, W., Te Pirita, R.D., Rakaia	5	1
INVERNESS FAVOURITE.		
Mother Seed (Canterbury)—		
Adams, A. A., Annat	1	1½
Amyes, H. C., "Riversleigh," Annat, R.D.	2	1½
McCarthy, E., Prebbleton	2	5
Macdonald, R., Annat	1	10
Piner, E., Annat, R.D.	1	5
Ruddenklau, J. G., The Valley, Glenavy	2	12
MAJESTIC.		
Mother Seed (Canterbury)—		
Caldwell, G., Courtenay, R.D.	3	1
Crozier, W. J., Mount Hutt, R.D., Rakaia (Line A)	4	2
Crozier, W. J., Mount Hutt, R.D., Rakaia (Line B)	5	5
Penn, T. A., 39 Weston Road, Christchurch, N. 1 (Line A)	4	2
Penn, T. A., 39 Weston Road, Christchurch, N. 1 (Line B)	5	3
Penn, T. A., 39 Weston Road, Christchurch, N. 1 (Line C)	4	2
EARLY REGENT BOLTER.		
Mother Seed (Canterbury)—		
McLennan, C., Courtenay, R.D.	4	10
Oakley, W., Hororata	2	15
Pascoe, S., Halkett, R.D.	3	9
Wilson, M., Halkett, R.D.	3	1
IRON DUKE.		
Mother Seed (Canterbury)—		
Croft, R., "Glenlea," Amberley (Line A)	5	2
Penn, T. A., 39 Weston Road, Christchurch, N. 1 (Line A)	5	2
Penn, T. A., 39 Weston Road, Christchurch, N. 1 (Line B)	4	2
Mother Seed (Otago)—		
Heenan, T. D., Maungatua	4	1

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Area in Acres.
JERSEY BENNES.		
Mother Seed (Otago and Southland)—		
Burgess, D., West Plains, Invercargill	4	3
Miller, R., East Taieri (Line C)	3	1
Commercial Seed (Otago and Southland)—		
Hellyer, F., Macandrew Bay, Dunedin	5	1½
Kirk, R., Tapanui	5	1
AMERICAN WONDER.		
Mother Seed (Canterbury)—		
Franks, L. J., 88 Russley Road, Christchurch, N.W. 3	3	2
Penn, T. A., 39 Weston Road, Christchurch, N. 1	4	1
Wright, L. T., Annat	3	2
ARRAN CONSUL.		
Mother Seed (Canterbury)—		
Macdonald, R., Annat	5	2
Page, S. T., Sheffield	4	1
Piner, E., Annat	3	1
BRESEES PROLIFIC.		
Commercial Seed (Canterbury)—		
Crawford, R. T., Yaldhurst	6	4
Gallagher, M., Springston, R.D.	6	5
Marshall, D., Leeston, R.D.	6	15
ROBIN ADAIR.		
Commercial Seed (Canterbury)—		
Robinson, R. G., Ltd., Box 4, Papanui (Line A)	6	1
Robinson, R. G., Ltd., Box 4, Papanui (Line B)	6	1
UP-TO-DATE.		
Mother Seed (Otago)—		
Sanders, W. M., Rockford, Clinton	4	1
Commercial Seed (Canterbury)—		
Steele, J., Kimberley	8	3
BLACK KIDNEY.		
Mother Seed (Canterbury)—		
Robinson, R. G., Ltd., Box 4, Papanui	3	1
GREAT SCOT.		
Mother Seed (Canterbury)—		
Robinson, R. G., Ltd., Box 4, Papanui	3	1
SIR J. G. WILSON.		
Mother Seed (Canterbury)—		
Robinson, R. G., Ltd., Box 4, Papanui	5	1

—*Fields Division.*

The host range of pea-mosaic (previously known to attack peas, broad beans, and red clover) has been extended to include blue lupins, sweet peas, alsike, and subterranean clover. The disease has a very marked effect on time of maturity and yield of garden peas. Two varieties have been found that, up to the present, are immune to the disease.—*Report, Mycologist.*

SEASONAL NOTES.

THE FARM.

Determining advisability of Special Cropping.

SOON, on many farms the major portions of which rightly are in grassland, it will be necessary to decide without further delay what special crops other than grass are to be grown during the current season. It seems likely that at times the area devoted to such special crops is reduced to an undesirable extent because farmers are deterred from growing them on account of estimates of cost of production which are quite misleading. But brief consideration should suffice to make clear the important fact that statements about the cost of production of crops if they profess to cover all items are, in practice, necessarily inaccurate for a great many farms. This is because so few farms replicate exactly in all important respects what is called the "average" farm to which the estimates in theory apply. Indeed, the real cost of growing specific crops usually cannot be determined accurately in respect to any individual farms (apart from one-crop farms), and it is unreasonable to expect greater accuracy when a number of farms are grouped for consideration. On a strictly academic basis of estimation the cost of special crops usually is made to appear considerable. But, as a rule, much of this cost relates to work done by the labour ordinarily employed and with equipment already provided independently of the special crop. Such expenditure is met whether or not the special crop is grown. Hence the practical question really is largely one of alternative use of land, labour, and equipment: can the land, labour, and equipment be employed more remuneratively than in growing certain special crops. Certainly at times some supplementary outlay on labour and equipment may be advisable if special crops are to be grown, but, as a rule, the major question is largely one of alternative use. No general answer can be given to this question: in answering it each farmer must consider his particular circumstances. He must concern himself not so much with the academic cost of a crop, but, among various things, he should determine what will be the direct outlay needed, to what extent the growing of the crop will affect the efficiency of other farm-work, to what extent the special crop is necessary to or conforms with any scheme of pasture-improvement, and in what manner the special crop will influence the returns from all the different kinds of farm-stock being kept. The latter matters are of particular importance—for instance, it may be advisable for one farmer and inadvisable for his neighbour to grow roots for winter feed; improvement of certain pastures of the former may be effected most profitably by way of the plough, whereas the pastures of the latter already may be improved. Similarly the farmers who are endeavouring to exploit fully pig-keeping as a side-line, or who make a feature of raising their own replacement stock, are likely to have greater need of special crops than farmers who are not doing so.

From the above considerations it may be deduced that the advisability of growing special crops cannot be decided upon the basis of cost alone. Indeed, it is ordinarily a complicated matter which cannot be decided lightly. To show, for instance, that a given amount of feed can be provided more cheaply by using permanent pastures than by using special crops does not necessarily enable any reliable decision to be made, for much depends upon when the feed from the different sources becomes available, and how the future production of the farm is affected.

One outstanding fact bears on the position—the feed during the off-seasons of grass-growth is in many cases inadequate, and in a substantial

number of these cases the growing of special crops not only would remedy the position, but also would prove very profitable. In this respect two crops that certainly could be grown more widely with advantage are lucerne and the mangel. Frequently preparatory cultivation for these crops should be commenced at an early date, if it has not already been commenced.

The Value of the Mangel.

The farmers' field competitions, which have been conducted over a wide range of conditions for many years, have provided striking field evidence of the value of the mangel when it receives suitable treatment. During recent years the average yield of some hundreds of crops has been approximately 60 tons an acre: on the basis of their content of nutriment if hay of average quality is worth £3 a ton, then mangels are worth at least 10s. a ton, so that a well-grown acre of mangels is worth £30. Actually, of course, the yield of many crops is much nearer 30 tons an acre than 60 tons. But the field competitions have been useful in showing that, as a rule, there is no essential reason why farmers should be satisfied with such low yields. It is of particular current moment that extensive experience shows not only that success with the mangel is linked with good treatment, but also that early preparatory cultivation is an important part of this good treatment. It has been found that the land devoted to the mangel well may be of the highest possible fertility; hence it is often advisable to dress liberally the future mangel area with farmyard and similar organic manure available from sheds, stack-bottoms, &c. When possible such organic manure should be applied before the land is ploughed; hence the distribution of the organic manure may well be carried out without delay.

Extension of Lucerne-culture desirable.

New Zealand experience in respect to lucerne merely confirms that of other countries by showing definitely that it is misconception to believe that lucerne is particularly exacting in its requirements. This misconception is largely the cause of lucerne not being grown as widely as is warranted by its intrinsic worth. Field experience has shown that lucerne can be grown successfully on practically all types of naturally well-drained soils. Deep, open, fertile soils are undoubtedly best for lucerne, which does not reach its maximum production unless both surface-drainage and under-drainage are good. Young lucerne is not capable of battling well against weeds, especially perennial ones—a fact which should be borne in mind in selecting and preparing land for lucerne. This explains why lucerne may well follow old pasture when the land is skim-ploughed well ahead of the time of seeding and subsequently ploughed deeply once only, so that seeds of weeds occurring in the surface layer may be covered with such a depth of soil that they remain dormant provided they are not brought back to the surface layer by later cultivation. Land which recently has been under the plough should be sown in lucerne only if it has been kept "clean" while in the arable condition, either by fallowing or by the growing of fallow crops such as mangels and potatoes which have really cleaned the ground, or by the growing of "smothering" crops such as oats and tares, which weaken weeds. At times, for some obscure reason, the area chosen for lucerne is one of the poorest and one on which no other crops can be grown successfully, with the result, which is not surprising, that the production of the lucerne sometimes is not attractive. Actually lucerne has so many merits that especial care should be taken to select for it not poor unproductive soil, but the most suitable of the soils available. Further information about lucerne is given in this Department's Bulletin No. 155, which is available for free distribution.

Annual Forage Crops.

The value for particular purposes of swedes, carrots, chou moellier, and soft turnips under suitable conditions and management is so well

established that these crops usually should be considered in any cropping programme designed to provide feed during the periods of scant direct supply of feed from permanent pastures.

Tillage for Arable Crops.

Generally in the latter part of June and in July seed-sowing should be avoided, but, as spring oats and wheat usually are sown in August and September and barley in September or early October, it is most advisable in June and July to make all possible progress with the tillage work in preparation for these cereals. However, in July on heavy soils there is often so much water present that tillage would be injurious; injury to the soil may be expected when the soil clings freely to boots or to implements that pass over it, and, when this is so, cultivation, even though it is urgent, should be deferred.

Winter Feeding of Stock.

Poor winter feeding of stock is one of the commonest and most grevious weaknesses in New Zealand farming. The feeding of developing dairy heifers and of hoggets unfortunately often is far below the needs of the animals. Such developing stock are readily susceptible to serious and possibly permanent setbacks as a result of malnutrition in the winter, and the harm which results is likely to be greatly intensified if the stock are infested with internal parasites. The permanent setback may take the form of stunting in size, which experience shows is associated usually with a corresponding stunting in production. Hence it may be expected to prove profitable eventually to give both heifers and hoggets the best feed available. Feeding of straw, poor hay, or stemmy grass-growth is not consistent with this. Feed, such as leafy grass, good hay, roots, and green crops, which is relatively rich in digestible supplies of body-building material is required.

Usually July is a critical month in the feeding of pregnant dairy cows and ewes. During the period when she is not yielding milk the dairy cow should be fed liberally enough to bring about what in Britain aptly has been called a "steaming up" process, which results in recuperation and renewal of bodily reserves, which are particularly likely to be depleted in heavy producers. Feeding that begets this result is considered to assist greatly in warding off udder and other disorders that commonly occur at about calving-time.

New Zealand investigations have demonstrated the importance of good winter-feeding of ewes kept primarily for fat-lamb production; it has been found that the economical production of fat lambs depends to a considerable extent upon obtaining lambs of good weight at birth, and this in turn, as might be expected, is determined by good winter feeding of the ewes.

Field evidence which is being accumulated goes to show that the position in pig-raising is essentially similar; that success with litters and profits from the wintering of stores both depend primarily upon the adequacy of the winter feeding, and that while other matters, such as good housing, may also be essential to success, due attention to these latter matters do not bring success if the feeding is neglected.

The farmer who already has not made provision for the adequate feeding of his stock cannot at this stage do much to remedy the position apart from resorting to purchased feed. But, nevertheless, some good will be achieved by directing attention to the value of good winter feeding at this stage, if it leads to the planning of better supplies of feed for the following winter—a matter which now should be receiving attention.

In the feeding of roots, carrots and mangels should follow swedes in the order given: the mangels may be kept longest because of their particularly good keeping qualities. Chou moellier usually is in good condition for feeding in July, when it generally should be used, for sometimes in August it tends to run to flower-stalks.

Roots and silage may be classed generally as somewhat watery bulky feeds, and so it is better to feed roots and hay than rations of roots alone or of roots and silage. Silage alone has been used at times as a winter supplement to pastures with good results, and this even when very little feed was obtainable from the pastures, but the prolonged feeding of roots alone may lead to disorders such as red-water. Whether better results are obtainable from silage by using it alone or in conjunction with hay in winter is a question about which the evidence available does not allow of a definite answer. Probably much depends upon the respective qualities of the hay and silage; however, certain farmers feed silage alone successfully, especially at about calving-time, and claim that they thus have less calving trouble than if they had substituted hay for the silage. Similarly silage has been fed successfully to ewes right up to lambing time. A typical satisfactory full-maintenance daily ration for a dry in-calf dairy cow is approximately 40 lb. mangels together with 12 lb. of average hay. When it is remembered that the nutritive equivalent of this ration is 50 lb. of ordinary grass silage, the cause of the tendency towards under-feeding of silage mentioned in these notes last month becomes obvious.

Cereals sown in the autumn should be fed-off before the growth becomes too long; in general two light feedings of short growth are more satisfactory and involve less waste than one feeding of heavy growth. Autumn-sown green cereals have been used successfully at this stage for pig-grazing when the amount of feed available from the pastures has been undesirably small.

Work with Pastures.

Extensive experience has shown that pasture top-dressing may be carried out with good results during July where it has not been done earlier. Usually it is desirable that such top-dressing bring about additional growth as quickly as possible, and when this is the case then generally superphosphate should be used. Even on somewhat heavy soils in a relatively cold North Island district superphosphate applied in July has produced substantial increases in the amount of feed available in August. It is not to be deduced from this that July is usually the most suitable month for the application of superphosphate: Previously in these notes the application much earlier in the season of superphosphate, as well as of phosphates of somewhat slower effect, has been recommended. But if top-dressing for some reason or another has not yet been done it may still be carried out with potentialities of profitable results.

Under normal conditions the application of nitrogenous manure about mid-July along the lines discussed in these notes last month usually gives a substantial increase in the feed available from the dressed paddocks in August and September. For a few weeks prior to mid-July it is widely advisable not to apply quickly acting nitrogenous fertilizers which act little if at all during the period when pasture-plants are most dormant.

During July harrowing of pastures normally should be carried out: it is particularly advisable on fields which have been stocked heavily with cattle during May and June.

Suitable pastures, preferably well-drained ones provided with shelter, should often be closed up during July for the use later on of early-calving or early-lambing stock. On such paddocks rye-grass is of especial value because of its early growth when the drainage is reasonably good.

An unusually wet winter is often followed by an exceptional abundance on pastures of such weeds as spear-thistles and docks. This points to the desirability of avoiding as much as possible "poaching" or "pugging" of pastures, which creates the bare spots in the sward on which such weeds establish. When a whole farm is wet at least some "pugging" is unavoidable, but attention to the following two rules is likely to assist in minimizing the damage from poaching: firstly, feed out hay and roots on the poorer portions which are likely to be the earliest to be put under

the plough and which will be improved valuably in fertility by such feeding; secondly, avoid as far as possible the stocking of the most low-lying paddocks.

Pastures which have suffered attacks of the grass-grub, if not so seriously damaged as to call for renewal, usually benefit from having hay and roots fed out on them.

Ensilage.

While one of the features of the farming of the last decade has been the expansion in the area of ensilage, there are still many farms on which it could be introduced or increased with profit. This is particularly true of sheep-farms, but it continues to be widely true also of dairy-farms. Possibly the desirable expansion in ensilage would take place more rapidly were it more generally realized how readily and cheaply suitable trenches or pits may be provided and how greatly they may be made to effect economy of labour and reduce wastage of the material being used. While many farms do not possess suitable locations for pits which are placed most advantageously on small hill-sides, trenches which are really shallow pits can be used efficiently much more commonly than is sometimes believed: trenches excavated on level land are being used widely with full success. Useful information about pits and trenches is contained in this Department's Bulletin No. 146, "Ensilage on the Farm."

Drainage.

This is the recognized time of the year for giving attention to drainage. The fact that the greater part of a drainage system is invisible makes it somewhat difficult to determine whether the system in all its parts is fully efficient in its action; hence care and thoroughness should characterize drainage work throughout.

At times it may not be practicable to provide thorough under-drainage. When this is so it is well to keep in mind that surface-drainage, which at times can be arranged with relative ease, usually is much better than no drainage.

While improved drainage results in greater returns from the use of suitable fertilizers and high-class seed, it does not follow that because land is poorly drained it should not receive dressings of fertilizer. Indeed in certain circumstances top-dressing of poorly drained land is definitely advisable: high fertility is required for full production of such species as meadow foxtail, *Poa trivialis*, and timothy, plants valuable for conditions so wet that rye-grass and cocksfoot would not tolerate them. Top-dressing by raising the fertility to meet the needs of such species will at times prove quite profitable. And, apart from such special cases, top-dressing of somewhat poorly drained land is frequently profitable although it would probably be more profitable with better drainage.

Apart from new drainage work there is at times need in July to do maintenance work to existing drains, which should be inspected regularly to observe how they are functioning. Winter provides good opportunities for determining how future drainage work should be carried out: usually it is easier in winter to obtain knowledge about the fall of the land, &c.

—R. P. Connell, Fields Division, Palmerston North.

THE ORCHARD.

The Pruning of the Apple.

THE main apple-pruning of the year is carried out during the winter when the tree is dormant. Briefly, the main objects of pruning are—(1) To secure a sturdy, well-formed tree; (2) to secure regular crops; (3) to increase the size and quality of the fruit; (4) to maintain these results over a profitable period.

The main principles which appear to operate in governing the growth of the tree may be summarized as follows: (1) The vigour of the tree is largely determined by its leaf surface; (2) the nearer a shoot approaches a vertical position the stronger will be its growth, and *vice versa*; (3) the sap flows most freely to the topmost parts of the tree; (4) the less the number of buds left upon a shoot the stronger are the resultant growths from each bud; (5) the fruit-production of the tree is correlated with its vegetative activity, and fruiting increases with decreasing tree-growth and decreases with excessive tree-growth.

The following is a brief statement of the practical application of these facts:—

The leaves of the tree are the food-elaborating organs, or, in other words, the lungs and stomach of the tree. Hence any definite reduction in their number must have the effect of depleting the supply of elaborated food, and must retard to a corresponding extent the growth of the tree. A healthy and adequate leaf surface is necessary for the extension of tree-growth and the production of fruit.

The strongest growth is obtained from vertical shoots, and therefore the vertical shoots are used in building up the framework of the tree, and the more horizontal shoots are utilized for fruit-production.

Unless regulated, the top of the tree produces the most vigorous shoots and absorbs most of the sap to the detriment of the lower portions of the tree.

The harder is the cutting-back of a shoot the stronger is the resultant growth. Hence the harder is the pruning of a tree the more new growth it produces.

As the amount of new growth produced decreases so the fruiting tendency increases: conversely, the stronger a tree is growing the less the tendency to fruit.

Most growers are familiar with the rank-growing tree which fails to produce much fruit, and the more it is cut the more it grows. Of common occurrence is the tree which fails to make new growth and is stagnant, and is prevented by the heavy crops carried from becoming a well-sized tree. Both are extremes to be avoided, and the wise grower endeavours to secure a balanced tree with respect to new growth and fruiting.

The following statements refer mainly to the treatment advised for trees which are already in bearing, the matter relative to the pruning of young trees being an exception to this.

The growth of the tree may be divided as follows: the permanent wood and the temporary wood. The permanent wood consists of the trunk, leaders, and fruiting-arms, and the temporary wood, which is constantly being removed or renewed, consists of all classes of laterals and spurs.

During the first few years the main consideration of the grower should be the building-up of the permanent parts of the tree and the production of a sturdy and well-spaced framework, which in later years is capable of carrying heavy and consistent crops. Fruiting of the young tree is not desirable, as this tends to reduce the vigour of the tree, and, if not controlled, eventually has a stunting effect on all but the trees of strongest growth. The weaker the growth of the tree the longer it should be prevented from fruiting. The tree should be developed first, and fruiting allowed to follow as a natural sequence when a tree of satisfactory size has been secured.

The erect growths, being most vigorous, are those from which the leaders or framework is secured. It is well to remember that a few sturdy and well-spaced leaders are preferable to numerous crowded and spindly leaders.

The pruning of the young trees should encourage vigorous growth of the leaders, and produce a well-formed tree. As the tree grows older overcrowding should be avoided. The centre of the tree should be kept open,

and sufficient space provided between adjacent leaders to allow of the proper development of the laterals which emerge from them. Fruiting-arms should be encouraged on the outside of the leaders, usually two or three per leader being sufficient. These arms should in turn carry laterals, twigs, fruit-spurs, and fruit-buds. The bulk of the fruit should be encouraged to form on the outside of the tree so that it is exposed to an abundance of sunshine and air. The leaders should be grown at an angle of about 40 degrees so that they maintain vigour and are also capable of bearing the complement of fruit and foliage without being bent out of position.

As the tree becomes older the laterals and spurs increase in number, and, unless thinned out, cause overcrowding of the fruiting-wood. With the tree in bearing, consideration turns to treatment of the temporary parts of the tree, the permanent parts having already been satisfactorily formed. The fruit carried on the old and worn-out spurs and laterals is generally of small size, has not the quality of the other fruits, and is more easily affected with russet. Hence the old and effete spurs and laterals should be gradually removed to give place to fresh growth.

The treatment of bearing trees is referred to as refurnishing, and this refurnishing is applied to the temporary parts of the tree. Each winter from 12 per cent. to 20 per cent. of the fruiting wood should be renewed, and in each instance the older and more worn-out spurs and laterals should be removed. This type of treatment gives three types of temporary wood: (*a*) The older and useless fruiting wood; (*b*) the young, well-conditioned fruiting wood; (*c*) the new shoots, or annual growths.

The class of laterals and spurs constituting the older and useless fruiting wood should be cut right back to the last bud, with the intention of renewing it. In the case of the young well-conditioned fruiting wood which represents the prospective crop, the laterals and spurs should be thinned and shortened only where necessary to prevent overcrowding. The annual growth of new shoots should not on any account be shortened. When required for future fruiting the young shoots should be left intact, otherwise they should be cut right away to prevent overcrowding. The shortening or cutting in half of these young growths only tends to produce excessive growth, eventually to the detriment of fruiting.

In brief, the desirable tree is a comparatively erect one, with approximately six to eight sturdy leaders, on the outside of which are an average of two fruiting-arms per leader. This permanent wood is well spaced and capable of carrying the weight of the crop. The tree is clothed with the temporary wood, mainly laterals, and also spurs, and there is approximately 15 per cent. of each of one-, two-, three-, four-, five-, and six-year old wood. This temporary wood is well spaced relative to light and air. All diseased and damaged wood should be removed. The refurnishing occupies a six-year cycle, and at no time does excessive cutting occur; therefore in each season the tree-growth is approximately the same—never stagnant, yet, on the other hand, never over-vigorous. The heaviest crops consistent with healthy trees may be carried, and crops are produced regularly.

As the treatment recommended is in some respects contrary to that adopted by many, points worthy of note are—(1) Laterals are produced primarily for fruiting; (2) shortening the annual growth induces the production of new extension growth; (3) leaving the annual growth uncut promotes fruit-shoots and bud-development. Therefore the cutting of the laterals promotes excessive new growth in the normal tree, which does not favour fruiting. Hence they should be left uncut, except where they are causing overcrowding, and then each offending lateral should be totally removed and the others allowed to fulfil their normal function—that of producing fruit shoots and buds, and ultimately fruit.

With the different types of tree such as Ballarat, an erect grower, and Jonathan, a willowy type of spreading habit, the pruner needs to exercise care during the formation of the framework. Trees of the more willowy

type need to be carefully pruned to get them to grow erect, and it is usual to prune them to inside buds on the leaders to secure this. Some varieties, such as the Jonathan, naturally produce laterals, and other varieties, such as Dunn's Favourite and Sturmer, are what are termed spur-bearers. It is found a wise practice to encourage laterals to form on all spur-bearing varieties, as far as possible.

The pruning of the bearing tree may be summed up as the gradual thinning-out of the spent fruiting wood and its replacement with fresh growth. It is inadvisable to cut the new growth and leave the old as is so frequently done. The old growth should be pruned away and the fresh growth allowed to develop into fruiting wood. It is advisable to avoid throwing the bearing tree into excessive growth. To revitalize a stagnant tree the procedure should be to reduce drastically the fruiting wood by pruning rather than by severely reducing the head of the tree.

The Pruning of the Pear.

The pruning of pears is not greatly dissimilar from that of apples. Pears, as a general rule, are more prone to become spur-bearers, and some varieties, such as Winter Nelis, are such prolific producers of spurs that frequently fruit-bearing is retarded owing to this over-supply of worn-out and effete buds. A drastic thinning-out of these spurs is required in such cases. As with apples, a thinning-out of the worn-out wood, followed by its replacement with fresh growth, is required. Young laterals should be either left uncut for fruiting, or removed entirely if causing overcrowding. Rational pruning aims at the production of regular and heavy crops, and, if followed, at no time will the tree be thrown into excessive growth, nor will stagnation result. Either of these extremes is the result of a faulty system of pruning.

General.

If the ploughing is not already completed it should be pushed ahead as rapidly as possible and the green crop turned under.

Drainage may be attended to as opportunity offers, as it is desirable that there be adequate drainage to remove the excess moisture and prevent "wet-feet" occurring among the trees. It is also desirable that wet soil conditions do not persist in the spring, when early soil-warmth is desirable and adequate drainage to remove the excessive winter rainfall is of great assistance in fostering warmth.

The working life of tile drains is greatly lengthened if coarse gravel followed by fine gravel is filled directly on to the drain-pipes to a depth of 3 in., the ditch then being filled with earth. Less silting-up of the pipes is likely to result from the use of the gravel.

On wet days the spray outfit, if under cover, may be overhauled. The tractor and other implements should be overhauled on wet days as opportunity offers, and placed in readiness for the next season. Grease on the movable parts and a coat of paint will lengthen the life of all implements, and the cost of this treatment is money well expended. Vexatious delays through faults developing and breakages occurring when the implements are in operation can often be obviated by inspection and overhaul during slack days.

—*R. G. Hamilton, Orchard Instructor, Hamilton.*

Citrus Notes.

Now that the time for the picking of the main crop of lemons is approaching, the need for carefully placing lemons and other citrus fruit in the picking-bag, and for carefully handling them in the transference to the orchard-box, and in the subsequent cartage to the shed, cannot be too strongly emphasized. The orchard-boxes, which should not be filled too full, should be washed to remove possible sources of mould infection after each picking, and carefully examined for protruding nails and splinters

which are likely to cause injury to fruits coming in contact with them and which should be removed. Care in handling is one of the greatest factors in keeping the lemon in sound condition while passing through the various stages of storage until the curing is completed. Pickers should be equipped with gloves so as to eliminate any danger of rupturing the delicate oil-cells on the surface of the skin. When picking the lemon two cuts should be made, the first close up to a matured bud on the lateral and the second directly behind the button on the lemon, as any small portion of stem left hardens in a few days, and in the course of subsequent handling in the curing-shed is a source of injury to other lemons with which the stem comes in contact, with the consequent wastage from blue mould and other rots.

After the lemons have been picked for a few days the outer surface of the skin becomes slightly tougher, but is still very subject to injury, so careful handling should be the slogan right through. Growers, whose attention is drawn to the Local Market Grading Regulations, should so standardize and market their lemons that much of the low-grade fruit which up to the present has been finding its way to the local market becomes entirely eliminated, to the subsequent benefit of all growers of citrus fruit.

The sheds and their surroundings should be kept clean and free of mould-infected fruits. Mould-infected fruits should be handled so as to prevent as far as possible the dissemination of spores in the atmosphere which takes place when mould-infected lemons are thrown into open containers.

—L. Paynter, Orchard Instructor, Auckland.

POULTRY-KEEPING.

Artificial Incubation.

If only one small incubator is to be worked, the question of the place where it is to be operated does not call for much thought, as any quite well-ventilated room suits the purpose, but it is advisable to have the room handy so that the necessary attention can be given easily to the machine.

In countries where great extremes of heat and cold are experienced, special incubator cellars are built, but it is not necessary to go to such expense in this Dominion. However, where a number of kerosene-lamp machines are operated, it is well to bear in mind that the lamps are burning night and day and consuming a large amount of oxygen, and also that from the first week of incubation the growing embryo requires a regular supply of oxygen in order to develop into a strong, healthy, and lively chicken. A mistake is often made of crowding too many machines into one room.

If a stuffiness or strong smell of kerosene is noticed when the incubator-room is entered in the morning, it is a sure sign that more ventilation is required, and, unless the incubator-room is well ventilated and the atmosphere constantly changed by a movement of fresh air, that supply of oxygen so necessary for success is not likely to be available. It is well to make provision for the air to enter the room from below the level of the machines so that a pure supply can pass into the egg-chamber before being contaminated by the fumes from the lamps. Ventilation should also be arranged near the roof so that all impure air may escape. Some troubles experienced during the brooding period may be traced to incorrect ventilation. Farms have been visited where trouble was experienced for several seasons with the rearing of chickens, but after the owners decided to get the hatching done by a more successful incubator-operator they had little trouble in rearing fine flocks of pullets. Such experience indicates that correct incubation has a large bearing on the rearing of the chickens.

Experiments have shown that best results were obtained from kerosene-lamp machines where they were operated in a room giving at least 2 cubic feet of air-space for each egg undergoing incubation.

While ample ventilation is necessary, care must be taken to see that no direct draught is allowed on the lamp, as this may cause smoking and perhaps fire. As correct even temperature during the incubation period is a very important factor in successful incubation, it is well to see that the sun's rays do not strike through the window directly on to the machine, as such rays are likely to cause variations which should be avoided. The jarring of the eggs, which may be caused by the slamming of doors or the bumping of the machine, should be guarded against. The chief points of good incubation are the keeping of a fairly even temperature in the room, quietness, and good ventilation.

The Incubator.

It is not the cost of the incubator that counts so much as the cost of the eggs that are placed in it. It is wise, therefore, to avoid cheap or second-hand machines of unknown make. There are, of course, many good, second-hand, reliable incubators, especially since a number of poultry-keepers have installed large mammoth machines, but the beginner should guard against the risk of starting off with incubators of unknown efficiency just because they can be procured for a few shillings less than dependable ones. Many very disappointing results have been due to this.

If the desirable conditions for the eggs are not provided in the room or incubator during the period of incubation, only the very strongest germs hatch, and even then those that do hatch under unsatisfactory conditions can hardly be expected to turn out as well as those hatched under the best conditions.

How to start an Incubator.

Every maker sends out with each incubator a set of instructions as to the setting-up and working of it, and, as he is anxious that the best results should be obtained, his instructions should be followed carefully, as he is the best qualified to advise.

It is essential to set the machine level in order that the temperature is as even as possible throughout the egg-chamber. If the incubator has been used previously it should be given a good overhaul before the season starts. Hot water and soda should be run through the pipes. The interior of the egg-chamber should be fumigated between each hatch. This can be done by placing a small quantity of Condy's fluid mixed with a small quantity of formalin on a saucer in the machine, and closing the door for a couple of hours.

Thermometers should be tested before starting operations each season. This can be done by placing a clinical thermometer and that to be tested in a basin of hot water, about 100° F. It has been found that some thermometers may register correctly one year but may be a degree out, or even more, the next year. If no clinical thermometer is on hand the local chemist will no doubt oblige by doing the testing.

Soft or rain water should always be used to fill the pipes in water machines, as hard or spring water is more likely to have a bad effect on pipes and solder. The machine should be heated up slowly and allowed to run empty for a day or two, or at least until it has been properly regulated.

Eggs for Incubation.

Eggs for incubation should be as fresh as possible, for seldom do eggs over ten days old give satisfactory results.

During the early part of the season, especially during very cold weather, it is advisable to collect eggs twice a day, and when eggs are held for incubation purposes it is well to cover them at night in order to protect them against frost. Only those of a good shape, size, colour, and texture of shell should be set. Very large eggs seldom hatch well, and it is not wise to set eggs under 2 oz. in weight. When placing them in the machine it is advisable to see that the air-cell is slightly higher. Better results are

secured if the egg-trays are not overcrowded, and on no account should eggs be heaped on top of one another. Experience has shown that the best results are obtained when machines are run a little below their full capacity. The eggs should be heated up slowly, for if heated up too quickly broken yolks may result. Especially is this so when incubating duck-eggs.

Turning of Eggs.

After placing eggs in the machine, do not disturb them for at least thirty-six hours, and then it is well to turn them once each day during the first week of incubation and twice each day from then on until the eighteenth day. The object of turning the eggs is to prevent the yolk from settling down towards the shell, and to give the developing embryo exercise and a fresh feeding-ground. It is not necessary for each egg to be turned exactly over, so long as each egg is moved gently. As all parts of the egg-chamber are not always at the same temperature, by moving the eggs about and turning the trays better results are obtained. However, it is essential that eggs be handled gently, as jarring or rough handling often causes crippled or deformed chickens.

Cooling of Eggs.

The time that should be allowed for cooling depends upon the season of the year and the stage of incubation. During the first week about the time it takes to turn them will be sufficient cooling, and then two or three minutes extra each day should be about enough. If it takes more than an hour and a half to bring the eggs back to the required heat, less cooling should be given. Do not allow the eggs to get cold but return them to the machine while just luke warm.

Moisture.

Generally speaking better results and stronger chickens are obtained when moisture is applied at some period during incubation, but just when and how much should be applied at all seasons of the year and in all localities it is impossible to say. The maker's instructions should be carefully followed regarding this matter. It is a good plan to set a hen at the same time as the incubator, and if a comparison between the incubator and naturally hatched eggs is made, and the air-cell watched, much may be learned. The flow of air through the egg-chamber and the humidity of the air affects the amount of evaporation. It is only by experience that the correct amount of ventilation and moisture can be determined.

It is a good plan to keep a record of the working of each machine. If a record of such matters as the temperature at morning, noon, and night, when and how the ventilators are worked, when moisture is applied, and how long the eggs are cooled were kept one would soon learn how best to operate the incubator in any particular district.

It is just as well not to change the regulator too often, but as the embryo develops heat is thrown off and slight changes are required. Incubators are not difficult to work, and, as in most phases of poultry-culture, if the small details are attended to most of the up-to-date incubators give satisfactory results.

—C. J. C. Cussen, Chief Poultry Instructor, Wellington.

THE APIARY.

Moving of Bees.

AT this season of the year bees may be moved with perfect safety to a new location. If the work is left until spring, when the activities of the hive commence, the resultant loss of field bees will be enormous. More especially should advantage be taken of the bees' dormant condition if the hives are to be moved short distances only. The colonies are numerically weaker,

and there is usually little brood to become injured in transport. When hives are located for any length of time in one position the flying bees take full observation of every landmark, but as in the winter there are shorter periods of sunshine the flight of the bees is necessarily curtailed, and they usually return at a much shorter distance from the hive. In addition there are often periods of several days together during which they take no flight at all, and in consequence they must renew their acquaintance with their surroundings when an opportunity for flight occurs. Therefore if the hives are moved during a spell of bad weather the bees will take more readily to their new location when a fine day comes. Any bee-shifting operations should be completed before the end of July.

To secure bees for transit over a short distance sufficient ventilation can be provided by tacking a piece of wire gauze over the hive-entrance. It is then necessary only to secure the bottom and roof, and after making sure that there are no holes through which the bees can escape the hive may be carried with perfect safety.

The successful moving of bees over long distances calls for considerable preparation. All heavy combs should be secured, and only sufficient honey left in the hives to prevent the bees from starving during their journey. The most important factor is ventilation, and it is the neglect of this matter which leads, as a rule, to heavy losses when bees are being moved. The constant vibration of any vehicle tends to disturb the cluster, and the excitement caused thereby is sufficient to raise the temperature of the hive considerably, so that the bees are in danger of being suffocated and the brood scalded. These troubles can be avoided by the employment of wire screens. First see that the frames are made as secure as possible by inserting two wedges between the side of the hive and the top of the end frames. This prevents the frames from rocking during transit. The bottom-board should then be secured to the hive-body by means of crate-staples, driving one end of the staple into the hive-body and the other into the bottom-board. Usually six staples are sufficient. The screens can be made by using narrow laths nailed together to form a frame of the same dimensions as the hive-body, and covering this with wire cloth, such as is used for making queen-cages. The screens must be securely fastened to the top of the hive and the entrance covered with wire cloth. By this means ample ventilation is provided to ensure the safe carriage of the bees during the winter months.

In these days of motor transport the work of moving bees over long distances is greatly minimized, and the beekeeper is well advised to adopt this means if it can be obtained. In any case the beekeeper who has occasion to move bees should not relax any effort to make the hives secure when moving to a new location.

Dry Mats.

At intervals during the winter months the mats should be examined to note their condition. After heavy rain the mats are liable to become damp. Damp mats should be replaced by dry ones. To save delay a supply of dry mats should always be kept on hand. As far as possible, do not disturb the colonies when making an examination, and especially avoid jarring the hives. The roof can be carefully lifted and the mat examined. If the latter has to be removed see that the smoker is handy in case the bees are troublesome, but do not use smoke unless the bees have to be driven down. Remove the wet mat as speedily as possible, replace it with a dry one, and cover the hive.

Leaky Covers.

In cases where damp mats are found they usually point to defects in the covers, and it should be worth the beekeeper's while to remove these also. At all seasons the comfort of the bees should be one of the main considerations, and this factor cannot be ignored if successful wintering is to be expected. The labour involved in keeping the hives watertight repays

itself many times over, and prevents to a large extent the loss of heat generated by the bees. The beekeeper should aim at reducing the waste of energy of the bees by maintaining the heat of the cluster at an even temperature during the unproductive season, and this will be impossible where leaky roofs are tolerated. Successful wintering is a high test of the beekeeper's capabilities.

Permanent Shelter.

Now that the actual work of the apiary is off the beekeeper's hands for a while he may devote his attention to the matter of providing permanent shelter for the hives. If he has definitely decided on a permanent location for the apiary he should now set about the cultivation of a hedge of quick growth. This matter is a most important one, and ranks next to that of locality. It is noticeable in sheltered situations that the bees are able to take cleansing flights during the mild days of winter, whereas bees in unsheltered positions are often confined to their hives even on sunny days. An occasional flight in the winter is as necessary for the welfare of the bees as any provision the beekeeper can make for their comfort. In addition to protecting the bees during the winter months from stormy winds, an occasional flight is an incentive to increased brood-rearing in the spring and early summer.

Whatever shrubs or trees are provided for the purpose of producing a permanent hedge, they should be planted thickly and trimmed to produce abundant foliage, especially at the base. It is highly important that the plants are able to stand cutting back, so that the hedge can be kept at a reasonable height. Hedges grown to a height of 8 ft. to 10 ft., and no higher, will provide ample shelter for a large apiary, and there will be less trouble in taking swarms if the trees are kept to the height indicated. Location and situation must to a large extent influence the beekeeper in choosing the most suitable plants, but, whatever the hedge, the idea should be to form thick shelter and not to form a plantation.

—E. A. Earp, Senior Apiary Instructor, Wellington.

HORTICULTURE.

Seed-sowing.

In the warmer districts the new season commences during the month of July with the sowing of early crops outside so soon as a good seed-bed is available. A good seed-bed consists of a soil friable not merely on the surface, but to the full depth of the cultivation, suitably enriched with manures, and free from weeds. For sowing it is important that the soil be sufficiently dry to run freely.

With the object of now completing the preparation of land for seed-sowing, weed-seeds near the surface should be allowed to sprout, after which the plants may be destroyed readily by shallow hoeing in fine weather. The cultivation must be shallow to avoid bringing more weed-seeds to the surface. Where a generous application of farm manure, or green crop, and bonedust have been turned under it probably will be sufficient to broadcast and work in an ounce of superphosphate per square yard (nearly 3 cwt. per acre). Where the land is light a dressing of sulphate of potash very well may be included at a rate of rather less than an ounce to the square yard. Where manure has not been applied, the amount of these fertilizers may be at least doubled and a dressing of sulphate of ammonia included; in which case it is important on acid soils to be sure that the lime-requirement of the soil is supplied adequately, or the best results will not be obtained from these fertilizers.

A common mistake is to sow cheap seeds, and these much too thickly, thus greatly increasing the labour and producing an inferior crop. All expensive seeds are not good, but they usually are if obtained from a reputable firm which specializes in the class of supplies. Good seeds sown at a fraction of the usual rate will require little or no thinning and produce a superior crop at a much less cost. The parsnip is one of the few crops that are generally not over-sown. The supplies of potato-seed were, not long since, very unsatisfactory, but since the institution of the system of Government-certified seed the position has much improved. In the warmer districts especially, only certified seed should be sown, as the ravages of virus disease are much more rapid under such conditions, and local seed-stocks quickly deteriorate.

Where new land has been broken in and a fine tilth cannot be obtained, the smaller seeds cannot be sown over large areas; but in some instances plants may be raised in specially prepared beds for planting out. These beds require careful preparation, and, after sowing, a thin layer of sand or well-sieved thoroughly decayed manure spread over the surface will prevent the soil forming a hard crust and allow the seedlings to come through. Where satisfactory drainage under all conditions cannot be obtained, the crop should be grown on raised beds.

Vegetable Crops.

As winter crops of cabbage, cauliflower, broccoli, &c., are harvested, clear the land and prepare it for further cropping. Keep a sharp lookout for club-root disease and burn all infected material. Take the first opportunity when the land is sufficiently dry to hoe the weeds in crops of young spring cabbage and cauliflower; follow this up with a moderate dressing of nitrate or ammonia so soon as growth commences. If much nitrogen is required the addition of a little potash also will be an advantage at this period.

Established plantations of asparagus should now be cleaned up and given a dressing of manure and kainit, if it has not already been done. Rhubarb may be given a dressing of manure and superphosphate. Where new plantations of rhubarb are to be made, plant now a well-coloured variety in land that is clean and has received a generous dressing of manure, setting the crowns 2 in. below the surface, 2 ft. apart, and 3 ft. between the rows. Where asparagus is to be planted out during the month of August the preparation of the land should now be completed. Where this crop is to be planted out twelve months hence, a sowing should now be made so that, by providing a long growing season, strong plants will be available. Ample seed should be sown so that all weak plants may be discarded and only strong crowns planted out. Sow the seeds 2 in. to 3 in. deep, and sufficiently thinly to produce plants 3 in. to 4 in. apart, with 18 in. between the rows for large sowings.

Towards the end of the month of July plant out cabbage and cauliflowers, shallots and garlic, artichokes and, where temperatures are suitable, early potatoes. Especially on light land, sow onions, early turnips, shorthorn carrots, peas, radish, lettuce, and spinach; also broad beans. Sowing and planting should be done only where the preparation of the land has been completed and the soil is sufficiently dry; otherwise sowing and planting are better deferred until the conditions are right.

In warm districts tomato-plants are sometimes set out in unheated glasshouses towards the end of July, and in some cases this may be warranted, but usually the latter part of August is sufficiently early where artificial heating is not provided. An average soil and atmospheric temperature of about 55° F. is required at planting-time; and when the plants are established

a little ventilation should be given when the weather conditions are favourable. In preparation for planting the soil and subsoil should be made thoroughly wet by watering the land three or four weeks before planting is done. The plants should be set deeply without bringing the soil round the stem of the plant above the previous soil-level at which it was grown; the depression gradually is filled in later in the process of cultivation. When the house is planted each plant should be settled into position with water that is slightly warm. Distance between plants is most important: It should not be less than 12 in. apart and 24 in. between rows; 30 in. between rows is more desirable, especially in warm localities and where means for ventilation are inclined to be deficient.

Small and Sundry Fruits and Nuts.

There are trees and shrubs suited to almost every situation—in the garden, orchard, or paddock—for shade, shelter, ornament, and fruit. On flat alluvial land an avenue of walnuts set in well-proportioned spaces is a satisfying feature in more than one respect, while sweet chestnut on warm hilly country is not excelled for shade, timber, and good crops of nuts that are excellent when used as a vegetable. Almost every property is a separate problem in that the soil, climate, and contour vary; the selection of plants and their arrangement should be well thought out. Planting should then be done under good conditions so soon as convenient now and not later than the end of September in most instances.

For small fruits planted in beds or brakes the best preparation of the land is necessary, and specially must the ground be cleared of perennial weeds: further suggestions in this matter are given in the April number of the *Journal*. In the colder districts where strawberry-planting is done in the spring, it is best done now so soon as the soil is in condition, as is the planting of all hardy fruiting deciduous shrub plants. Passion-vines, tree-tomatoes, and Cape gooseberries are best planted in the month of October. In cold districts evergreen plants of this class may be planted towards the end of August or during the month of September. The pruning notes under the heading of the Homestead Garden in the May number of this *Journal* should be applied to young plants mentioned above after they have been planted out.

In established brakes of small fruits pruning should now be completed and prunings burnt, to destroy the larvæ of the clear-wing moth (*Sesia tipuliformis*), which commonly burrows the twigs and branches of currant and gooseberry bushes, as well as other pests which can to some extent be controlled by taking this precaution. Green crops between the rows or manures should now be carefully ploughed under. Avoid going more deeply than 6 in., or the plants will suffer owing to injury to their roots.

The Homestead Garden.

Alterations to established gardens or the laying-out of new ones should now be pushed along in order that they may be completed during the months of August or September.

In established gardens portions of the lawn where the turf is worn thin may be removed to a depth of about 2 in. and neatly replaced by fine turf of a similar character. Where the verge of a lawn has spread, cut it back true to the line, and where it is worn back from the verge carefully lift the turf and bring it forward, filling the space which is thus formed with new turf. On light land especially, a lawn is greatly improved now by applying a thin top-dressing of rich compost finely screened. In some cases lawns have been rather overcrowded with specimen trees and shrubs which destroy the restful character of the green and make the grass more difficult to cut; these may now be removed and the places turfed over. In the shrubbery

border new features may be introduced to give it character, improve the sky-line, or add brightness at certain seasons. This can be done readily now after giving the matter a little careful consideration. The foreground especially often requires a little adjustment in planting dwarf shrubs rather closely to cover the ground and hide the base of the taller plants at the back: azaleas, heaths, daphne, and, in exposed situations particularly, some of the dwarfer native veronicas are very suitable for this purpose. Herbaceous borders also may now be replanted when the land is in suitable condition.

Where a new garden is being made the cleaning and cultivation of the land should now be completed so soon as possible so that the soil has time to consolidate before planting and sowing down lawns. The height and grading of the surface requires careful consideration to obtain the best effect. The surface should always fall slightly from the dwelling outwards; if the natural contour of the land rises, as it frequently does in hilly country, at the back of a house, the outward fall may terminate in a water-table, which should be thoroughly well drained. Planting may be done so soon as the newly cultivated land has settled, and the plants should be pruned as described in this section of the May *Journal*. Land which is to be sown in grass should be hoed occasionally to destroy seedling weeds, and allowed to consolidate ready for sowing during the months of August or September.

—*W. C. Hyde, Horticulturist, Wellington.*

SEED-WHEAT CERTIFICATION.

CERTIFIED CROPS.

UNDER the Government scheme for the certification of seed-wheat, the following growers have seed from crops which have passed both field and grain inspections. (Previous lists, to which purchasers are also referred, were published in the March, April, and May issues of the *Journal*.)

Variety.	Grower.	Acreage.
Cross 7	R. C. Bean, Waiau	20
	*Mrs. E. Frizzell, Swannanoa	40
	Gardiner Bros., Upper Waitohi, Temuka	8
	*J. J. Hall, Otaio	10
	*J. A. McLeod, Tycho, Timaru ..	15
	*H. Richards, Box 78, Methven ..	8
Dreadnought ..	J. Forsyth, Willowbridge	10
	Government Pure Seed Station, Box 4, Lincoln	1
	*G. F. Sides, Studholme Junction ..	8½
Hunters II ..	*W. Bloomfield, Maerewhenua, via Oamaru	14
	G. Brown, Stirling	11
	*H. Evans, Upper Plain, Masterton ..	10
	*J. D. Wills, Tai Tapu	6
Solid Straw Tuscan	Mrs. B. Galletly, St. Andrews ..	10
	Gardiner Bros., Upper Waitohi, Temuka	25
	F. E. Morrish, Springston R.D. ..	4
	J. L. Morrison, Morven	25

* Passed subject to machine-dressing.

—*Fields Division.*

WEATHER RECORDS: MAY, 1936.

Dominion Meteorological Office.

NOTES FOR MAY.

ONE of the most notable south-westerly storms in the history of the country occurred on the 2nd May, and the weather remained wet and rather stormy until after the close of the first week. Thereafter there occurred a spell of settled weather, unprecedented for the time of year. From the 8th until the end of the month no considerable disturbance affected the Dominion. There was very little wind, but what there was came mainly from a southerly direction. Frosts and morning fogs were numerous; but there were many fine days, and conditions were never really severe. On the whole, little growth occurred in vegetation, and in certain districts pastures have been depleted. On the other hand, feed has in some cases been hardened and its nourishing properties consequently increased. In the principal dairying districts the milk-yield has fallen away, but stock are reported everywhere to be doing well.

Rainfall.—In parts of Central Otago and much of Southland, where there was a good deal of showery weather, the rainfall was above the average. Elsewhere the month was an extraordinarily dry one. The North Island had only about 60 per cent. of the normal fall, many places recording only about a quarter. Similar conditions prevailed in Nelson, Marlborough, and Canterbury.

Temperatures.—Temperatures were, in general, between two and three degrees below normal, making the month one of the coldest Mays on record. In parts of the interior of Canterbury and in the far South, however, the normal temperature was exceeded. Some hard frosts were experienced, especially in the north-central portions of the North Island.

Sunshine.—A good deal of cloud occurred in eastern areas in what was otherwise fine weather, but the great majority of places had considerably more than the average amount of bright sunshine.

Pressure Systems.—At the beginning of the month a deep cyclone was centred near Chatham Islands. Several secondary depressions moved into this from the west, each bringing lower pressure to the Dominion. The culmination came with the last of these, on the 2nd. Pressure was extraordinarily low over the whole New Zealand area and severe south-westerly gales were responsible for damage from one end to the other of the country. The weather was very cold, with frequent heavy showers, and, in many places, hail. Snow fell on the high levels, and a number of violent thunderstorms were experienced. A storm of such violence over so great an area has probably not previously been recorded in the Dominion.

On the 3rd pressure rose and the weather improved. The westerly type of weather continued to prevail, however, until the 7th. Conditions remained unsettled, with intermittent rain. During the 6th and 7th, there was practically general rain, with heavy falls in the ranges and western districts from Taranaki southwards. The 7th brought a southerly change and snow, again, on the high country.

From the 8th until the end of the month the air pressure throughout was frequently very high and fell below 30 in. for brief intervals only. The one causing the depression which involved the greatest fall of pressure passed on the 29th, and was followed by rather colder weather and a little snow again fell on some of the ranges. Generally speaking, however, the amount of snow on the mountains decreased during the month, and at the end there was less than usual at this time of year.

During the period between the 22nd and the 28th, scattered rains were recorded on most days in North Auckland, but the effect of the storms was much less than might have been expected.

Such rain as did occur after the 8th was very erratic in its incidence and frequently of a very local character.

RAINFALLS FOR MAY, 1936, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average May Rainfall.	Total Rainfall to Date.	Average Rainfall to Date.
			North Island.			
	Inches.		Inches.	Inches.	Inches.	Inches.
Kaitaia	1·86	10	0·66	6·61	24·27	21·57
Russell	3·03	11	0·57	7·07	54·15	20·84
Whangarei	2·11	12	0·72	7·88	34·66	25·06
Auckland	1·26	7	0·25	5·15	22·62	18·84
Hamilton	1·22	7	0·38	4·70	25·74	18·79
Rotorua	1·38	8	0·60	5·69	32·51	21·62
Kawhia	3·33	7	1·55	5·34	24·77	19·82
New Plymouth ..	2·03	9	1·22	6·20	25·00	22·59
Riversdale, Inglewood ..	3·80	12	2·23	9·69	40·37	38·38
Whangamomona ..	2·74	5	1·05	6·84	32·67	27·81
Hawera	1·94	10	0·52	4·58	20·17	16·98
Tairua	1·66	6	0·68	7·08	28·62	26·59
Tauranga	1·73	7	0·54	5·10	30·11	21·53
Maraehako Station, Opotiki	0·85	8	0·44	5·70	31·27	22·13
Gisborne	2·81	17	0·52	5·36	26·32	20·01
Taupo	0·73	6	0·36	3·95	23·63	16·80
Napier	1·89	9	0·66	3·18	27·74	13·16
Hastings	0·98	9	0·41	3·29	25·48	13·56
Whakarara Station ..	1·74	7	0·55	..	31·93	..
Taihape	2·25	12	0·54	3·46	22·81	14·43
Masterton	5·05	14	0·85	4·04	25·18	15·18
Patea	2·14	10	0·53	4·15	21·96	17·16
Wanganui	1·60	7	0·58	3·34	20·25	14·33
Foxton	0·95	8	0·30	3·19	18·92	11·88
Wellington	2·87	13	0·99	4·10	24·08	16·58
			South Island.			
Westport	4·61	11	1·51	8·35	24·91	37·65
Greymouth	3·78	9	1·37	8·10	29·93	40·76
Hokitika	4·55	10	1·83	9·58	29·46	45·87
Ross	5·40	11	2·75	9·83	35·75	54·04
Arthur's Pass ..	7·88	8	5·45	12·78	40·53	65·41
Okuru, South Westland	7·90	10	2·30	10·80	54·08	61·32
Collingwood	4·62	6	2·45	8·87	31·55	34·80
Nelson	1·02	4	0·54	3·26	12·31	14·81
Spring Creek, Blenheim	0·76	6	0·37	3·03	15·09	11·53
Seddon	0·44	5	0·31	2·83	13·22	10·23
Hanmer Springs ..	2·59	9	1·02	4·54	27·77	18·38
Highfield, Waiau ..	1·28	7	0·47	3·25	21·63	14·27
Gore Bay	1·88	6	0·58	3·41	19·31	13·18
Christchurch	1·36	11	0·52	2·62	18·48	10·10
Timaru	0·35	5	0·14	1·48	15·78	9·39
Lambrook Station, Fairlie	..	..	..	1·57	..	10·12
Benmore Station, Clearburn	0·61	6	0·25	1·79	8·50	10·99
Oamaru	0·50	5	0·20	1·60	14·10	9·00
Queenstown	3·14	8	0·95	2·59	14·54	13·13
Clyde	1·39	7	0·46	0·99	5·83	6·84
Dunedin	2·09	8	0·68	3·15	19·98	14·94
Wendon	2·31	12	0·50	1·98	13·96	12·89
Balclutha	3·12	13	0·75	1·92	12·40	10·72
Invercargill	4·36	26	1·10	4·36	18·39	19·67
Puysegur Point ..	5·38	18	1·12	6·67	34·07	35·67
Half-moon Bay ..	4·28	20	1·14	4·85	17·39	24·22